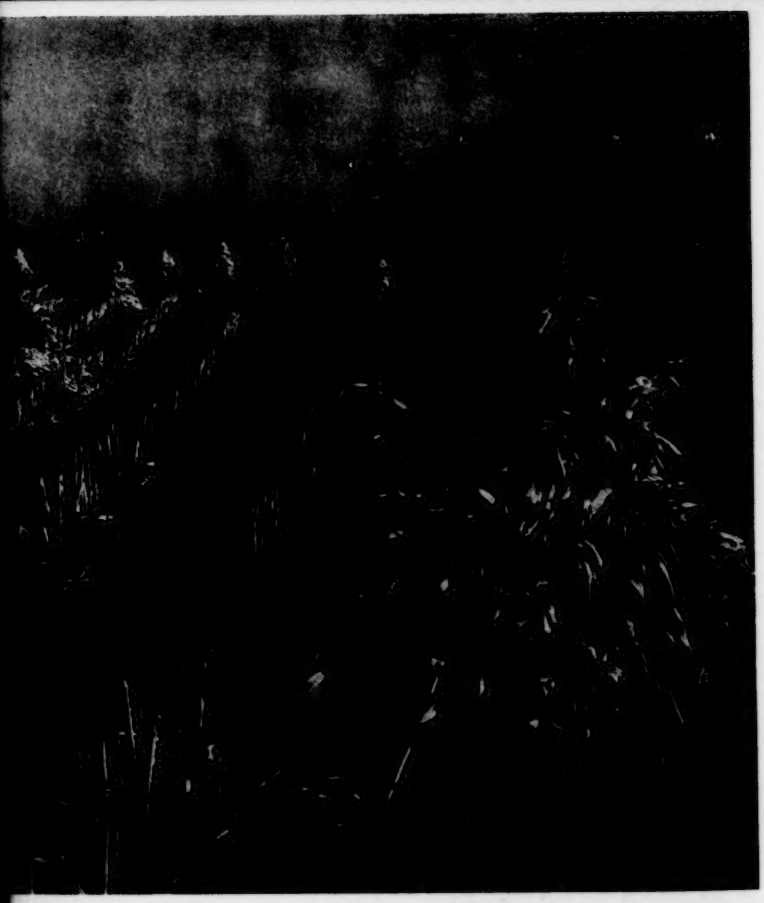

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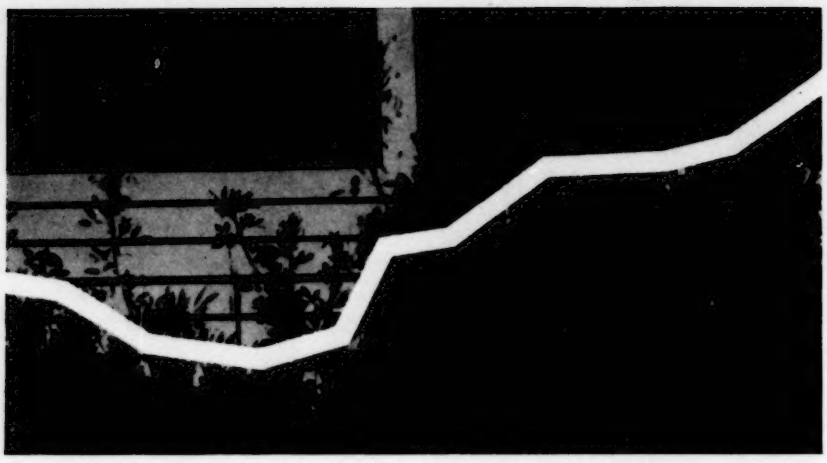

In a Washington State test, sweet clover responds to moly fertilization with yield of 1.5 tons of hay per acre (area at right). Control area (left) yielded only 0.7 ton per acre.

(Photo courtesy State College of Washington).

Average yield or high production? Moly may make the difference

Moly can give striking increases in yields, even on land farmers thought was "good enough"

During the past few years agronomists and many farmers have witnessed the dramatic upturn of crop yields when small additions of molybdenum were made to moly-starved soils. These results have been widely reported, and today the more obvious symptoms of moly-starvation are quickly recognized by most county agents.

But how about the much larger areas where moly-deficient soils might be described as undernourished rather than starved? Here moly can make the difference between average yields, average quality, average profits and high yields of premium quality crops that mean extra income.

At the present time these areas of potential response to moly treatment are known to include large parts of the eastern U.S. and much of the arable land of the Pacific Northwest. They take in many productive farms whose owners, lacking a standard of comparison, are reasonably satisfied with present yields.

In these areas, tests by experimental stations and growers alike have established that moly applications can boost yields by 12 to 93%. Although such improvements are not perhaps as spectacular as in moly-starved soils, they have already added to the profits of individual farmers. Broad-scale treatment of these undernourished soils can contribute substantially to overall farm production.

How Moly Works

A fact that has emerged from many studies of micronutrients is that moly is essential to nitrogen fixation. Legumes require moly for the fixation of atmospheric nitrogen by the bacteria in their root nodules. All crops need it to reduce nitrates to nitrogen—the first step in protein synthesis.

When there isn't enough available moly in the soil to satisfy plant requirements, crops literally starve to death (as in the case of serious, visible deficiencies), or achieve only a fraction of their potential growth (as in the case of many fields with "normal" productivity).

On the other hand, small amounts of moly have given both substantial increases in crop yields and marked improvement in quality to many farmers who were once content with fair to average production. In many cases alfalfa has a higher protein content when "normal" fields are treated with moly. Cauliflower runs to large size, more succulent flavor.

Consider the effect of moly on a typical few of the 30-odd crops for which responses have been reported:

Alfalfa—In field tests in New Jersey, Dr. Harold J. Evans of Rutgers University obtained an average increase in yield of 13%, marked improvement in protein content. In field tests in Spokane County, Washington, Dr. H. M. Reisenauer of the State College of Washington found that treating molybdenum deficient fields with moly increased yields an average of 40%.

Melons—A Virginia grower reports that with moly treatment he gets an average of 7 runners per vine with each runner bearing a large melon. Untreated plants bear fewer runners, much smaller fruit.

Peas—In eastern Washington and northern Idaho, where both dry edible and seed peas are a major crop, commercial use of moly is producing more peas per pod, more pods per vine. And vines are longer, easier to harvest. Yield increases in commercial tests have averaged 63%. Many farmers realize a return of $10 on each dollar invested in moly.

Cauliflower and Lettuce—Growers on Long Island and in upstate New York, in Rhode Island and mid-New Jersey report more vigorous cauliflower plants with heads of better quality. Color and leaf structure of lettuce improved. Yields were consistently higher than for untreated fields.

Testing is Easy

Although crops vary in their moly requirements and responses vary with soils, there is one sure way for a grower to find out whether he can increase the yield and quality of a particular crop on a particular soil: run a field test. It's easy to do.

A stock solution for such tests is made by dissolving one ounce of sodium molybdate in one gallon of water. For vegetable crops, select and mark one or more rows through the center of the field. Mix three cups of the stock solution with one gallon of water and apply to the test rows, using about a quart to a 250-foot row. Compare the test rows with untreated rows every other day. Check yields and quality against untreated areas at harvest.

For legumes, lay out a test plot 10 yards square in a location that will make it easy to compare with untreated soil. Follow the usual fertilizer plan, but do not use nitrogen on either the test plot or the control areas. Spray the test plot with three cups of stock moly solution to a gallon of water. This may be done at the time of seeding, or to an established stand. Because increases of 25% or less are difficult to evaluate visually, clipping tests should be made.

For detailed information on the handling of moly test plots write Climax Molybdenum Company, Dep't. 50, 500 Fifth Avenue, New York 36, N. Y.

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The John Deere 694 Corn Planter, shown here, can be equipped for fertilizing, spraying against weeds, and depositing insecticide in one operation with planting.

The 684 Corn and Cotton Planter, shown here, does an accurate job of drilling or hill-dropping on flatland, on beds, or in furrows, planting six rows on every trip across the field.

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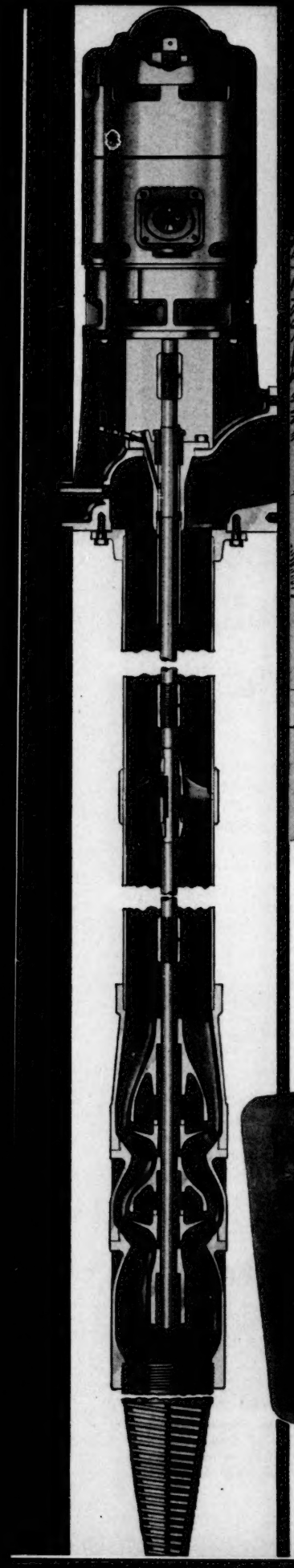

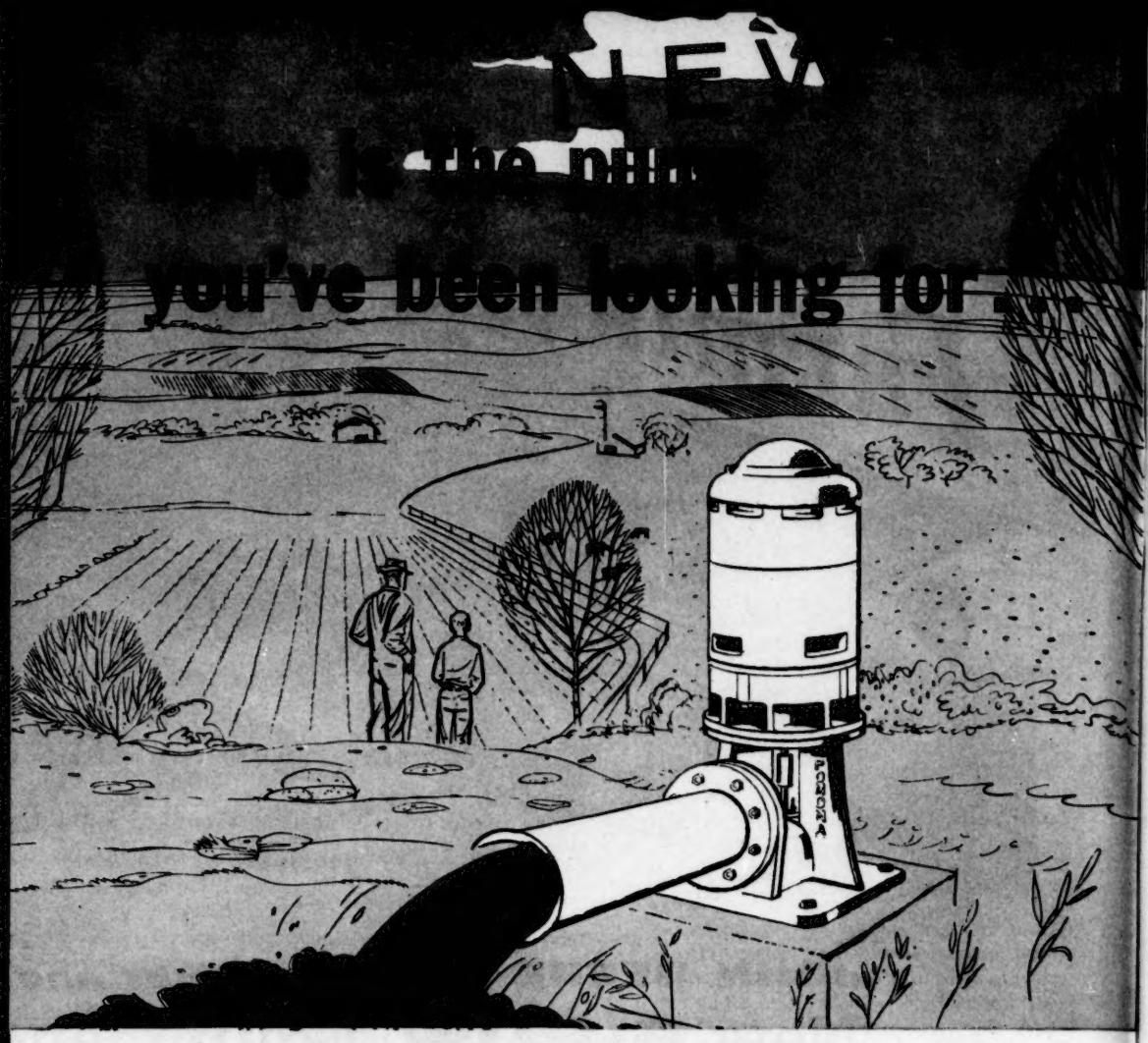

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Journal of SOIL AND WATER CONSERVATION

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New Holland's "440" mows and crushes in one operation

Tenderized hay makes a Grade A feed

WHAT is Grade "A" feed? Clearly it is feed which is at once rich in nutrients *and* especially sweet, tender and palatable. It is feed that promotes livestock health and insures maximum milk production or develops highest quality meat.

The recent development of the hay crushing technique has now made it possible to produce such feed easily and dependably. By splitting the stems lengthwise, the crusher promotes uniform curing. Stems and leaves dry evenly . . . are ready for raking in about half the time. As a result, leaves are less apt to be stripped from the stems and nutrient loss is further cut because exposure to the sun is reduced.

Samples of crushed Johnson grass showed twice the carotene content at baling time as non-crushed. Soybeans showed a similar improvement; with an increase of 2.4% in the protein content of the crushed samples.

Furthermore, crushing "tenderizes" the stems, making them more desirable for animals. In recent studies, heifers have eaten twice as many pounds daily of this tender, leafier, sweeter hay. And milking cows have been known to increase their consumption by one-third.

New Holland's 440 Mower Crusher mows and crushes in a single operation that takes no longer than mowing alone. It's another of the advanced haymaking machines that make far better hay quickly and economically. New Holland Machine Company Division of Sperry Rand Corporation, New Holland, Pennsylvania.

NEW HOLLAND *"First in Grassland Farming"*

Level Irrigation

P. EARL ROSS AND NORRIS P. SWANSON

Control of irrigation water to obtain uniform distribution over the land being irrigated is one of the most difficult problems of good water management in irrigated agriculture. Uniform water application is the first requisite for the efficient use of irrigation water. It is a predominant factor in the permanency of irrigated agriculture and continues to exist as a problem in most irrigated areas.

A METHOD of applying irrigation water to a level area in a short period of time and confining the water to the area until it is absorbed by the soil has been developed in the Southwest during recent years. The method is generally called "level irrigation."

Some aspects of level irrigation are not of recent development. Basin irrigation for orchards has been practiced for many years. Flooding in level checks has been commonly used for rice.

Level border strips and level furrows for irrigating general field crops, however, are comparatively new adaptations which were introduced in the Southwest by the Soil Conservation Service some 10 to 15 years ago. Although these adaptations are relatively new, enthusiastic acceptance by farmers who are using well-designed level irrigation systems properly is indicative of the value of such a system for better irrigation-water management.

Advantages of Level Irrigation

Level irrigation systems have many desirable and valuable qualities. Among these are (1) high application and distribution efficiencies, (2) increased crop production from better water distribution, (3) reduced labor costs, (4) increased utilization of rainfall, (5) reduced erosion from both rainfall and irrigation, (6) controlled deep percolation, (7) leaching for salinity control, and (8) the control of high water tables. Development of level irrigation is increasing rapidly as a result of one or more of these reasons.

1. *High application and distribution efficiencies* make level irrigation desirable in areas where water is not plentiful. As much as 90 per cent of the water applied to the land can be stored in the root zone of the crops when level systems are used. With graded irrigation losses by runoff and deep percolation often run as high as 70 per cent. The increased efficiency comes from uniform distribution of water and uniform depth of wetting. Thus under- and over-irrigated areas are avoided.

2. *Increased crop production* with level irrigation has frequently resulted because of the uniformity of water distribution. Farmer experience has shown that production is more than doubled in many instances as compared to previous application methods. Uniformity of seed germination, plant population, and the equal opportunity of every plant to receive water results in a uniform crop, and consequently in a substantial increase in crop production.

3. *Reduced labor costs* are made possible with well designed systems. Where good delivery systems such as underground pipe with turnout valves or permanent ditches with gates are installed, the only physical labor required is the opening and closing of the valves or gates. Critical adjustments of stream size necessary to obtain high irrigation efficiencies with graded irrigation systems are not required with level systems.

4. *Maximum utilization of rainfall and reduced erosion* are effected by level irrigation systems. Rainfall in excess of the intake rate of the soil can be held on the level field until it is stored in the soil profile. Maximum soil moisture storage is accomplished uniformly throughout the field. Loss by runoff and damage from erosion is eliminated by use of border ridges which confine the water to the area on which it falls. Where surface drainage facilities are required, the rate and amount of removal can be controlled readily with a properly designed system.

5. *Controlled deep percolation* with resulting control of high water tables can be accomplished where the use of comparatively rapid rates of application for initial coverage are used. Measured amounts of water applied make it possible to replenish the soil moisture above the water table without adding to the water table.

6. *Leaching for salinity control* is a job to which level

P. Earl Ross and Norris P. Swanson are Irrigation Engineers, respectively, Western Soil and Water Management Section, Soil and Water Conservation Research Branch, Agricultural Research Service, U. S. Department of Agriculture, Weslaco, Texas and Lincoln, Nebraska, formerly of Amarillo, Texas. Messrs. Monroe Hartman, Lester Lawhon, and Emil Studer (deceased) of the Soil Conservation Service also assisted in the pioneering of development of level irrigation in the Southwest. This paper is a contribution from the United States Department of Agriculture, Agricultural Research Service, and the Texas Agricultural Experiment Station, cooperating.

irrigation is naturally adapted since the water applied remains on the soil surface at a uniform depth until it moves through the soil profile or is lost by evaporation. A minimum amount of water is required for leaching. If desirable, a uniform leaching can be accomplished with every irrigation application. This may be important when applying water of low or doubtful quality.

Adaptations of Level Irrigation

Level irrigation is adapted to most crops and soils that can be irrigated satisfactorily by surface methods.

Its adaptation on any slope is limited only by the depth of soil required to permit the necessary land leveling. Slopes up to six per cent have been benched satisfactorily for level irrigation on deep soils. Shallow soils are often unsuited for level irrigation in that they will not permit the necessary leveling.

Level irrigation is not well suited to sandy soils which are subject to severe wind erosion because it may be difficult to maintain a uniformly level surface under such conditions. Level irrigation, like graded irrigation, has limitations on freely permeable soils with low water storage capacities. On clay, clay loam, and sandy loam soils, where the water intake rates are lower and storage capacities are higher, level irrigation simplifies water application considerably.

Level irrigation is adapted to the irrigation of subtilled, newly-plowed and mulched soils. These modifications permit the application of water to slowly permeable soils since both a rough, cloddy surface and residue in the surface contribute to increased water intake rates.

Amount of earth movement required for level irrigation will vary according to the slope of the land. Initial cost of land leveling is sometimes high. But careful study of elevation maps will often save expense in earth moving.

Areas on which the cuts and fills of earth are balanced may be on a field basis or a field may have several areas of different elevations. In cases of steeper slopes, each border strip may have a different elevation. In regions such as the Upper and Lower Rio Grande Valley of Texas, many farms with little land slope have been leveled on a field or even on a farm basis.

It is highly desirable to include as much area in one plane as practical. When a large number of benches are used only for the purpose of reducing costs in earth moving, the economy is generally false. The added expense of operating and maintaining the smaller leveled areas usually will offset the initial savings.

Leveling on Field Basis

Design of field leveling is relatively simple when soils are deep and uniform. Fills and cuts may be figured on a field without the necessity of specifying placement of fills or limitations on cuts from specific areas.

Mixed soils and soils of varying intake rates and storage capacities bring up problems of design regarding the cuts and fills. Insofar as practical each soil type in a field should be irrigated within separate confined areas. It is not always feasible to isolate small soil areas but they should be evaluated carefully in regard to the effect they may have upon application and distribution efficiencies.

Most irrigated soils permit some leveling without unduly changing intake and storage characteristics. Cuts and fills may either reduce or increase soil moisture storage capacity. In some instances stockpiling the surface soil for replacement on the surface in the final leveling may be desirable. Where this is necessary, construction can be planned so that cuts and fills will be made from and on subsoil without greatly increasing costs.

EFFICIENT use of irrigation water is one of the major advantages of level irrigation. Distribution is even over an entire area.

LABOR involved in attempting to hold water on graded land is often excessive. Even then, it may be futile. Level irrigation may be a way of avoiding the problem.

ATTEMPTS to adjust the stream flow for irrigation often fail on graded land. This is another problem avoided by level irrigation.

Where variations from fine-textured to coarse-textured soils exist in a field, it is sometimes possible to mix the surface soils in the leveling operation and obtain more uniform intake rates and some improvement in the uniformity of moisture storage. A goal of level irrigation is defeated if a range of disturbed soils with radically different intake rates and moisture storage capacities result from the land leveling operations.

Bench Leveling

In large fields, where the slope of the land is near or exceeds one per cent, the removal of the side slope generally prohibits the leveling of the entire field in one plane. When this is the case, bench leveling is employed. Slope of the land and permissible depth of cut determine maximum width of the bench. Maximum width is desirable for convenience in tillage operations and to reduce the amount of land in the escarpments between benches.

In bench leveling, side slope is removed from each benched area. The down slope edge of the bench must be provided with a ridge adequate to prevent runoff from the level area.

Where slopes are not uniform in direction and are too steep for straight benches, the benches should be built to align with the approximate contour of the land. However, the benches should have uniform width for ease in farming operation.

Design of Level Irrigation Systems

Competent engineering and good workmanship in land leveling are necessary in design and installation of level irrigation systems. The slope of the land should be zero for best performance. However, the workmanship involved in obtaining and maintaining such a refined grade in cultivated lands requires more precision than is usually available.

Experience shows that a gradient of as much as 0.05 foot per 100 feet does not materially reduce the efficiency of the irrigation. Therefore, many technicians provide grades of 0.02 to 0.05 per cent when designing the systems. However, on the longer irrigation runs it is generally wise to limit the total fall of the run to 0.2 of a foot. Such grades tend to overcome slight errors in land preparation which might cause shallow ponding or actually reverse the intended grade of the land.

Side slope (slope perpendicular to the direction of flow of irrigation water) must be eliminated for border irrigation. A side slope, generally not exceeding 0.2 per cent, is permissible where only furrow irrigation is used. Such a gradient reduces the amount of earth moving required on long sloping fields and in some instances expedites the flow of water in field laterals. When such side slope is used for an appreciable distance it is advantageous to use border ridges to confine the water to a definite number of rows to prevent any excess accumulation of runoff on the lower parts of the field.

Maintain Border Ridge

On level irrigation systems, it is extremely important to construct and maintain a border ridge across the distal end of the run. It causes the first irrigation water reaching the border ridge to reverse its flow and cover other parts of the area. Thus the initial coverage is completed more quickly. It holds the water on the soil at a uniform depth which affords better opportunity for uniform penetration. It prevents runoff losses from both irrigation and rainfall.

It is often desirable to use corrugations or furrows within border strips where drilled or broadcast crops are grown. They effect better water travel time and minimize small errors in land leveling and the effect of wind on water movement. A good leveling job is highly desir-

GRADED irrigation runs require careful handling of water. Otherwise, erosion and damage to soil structure may result. Where level irrigation is adopted, it can solve this problem.

able, however, even when furrows or corrugations are used.

When possible, the irrigation system should be oriented so that the direction of irrigation is not against the direction from which strong winds are known to prevail during the irrigation seasons. Wind movement will interfere with the movement of water on level land, particularly when there is little ground cover. The wind problem is usually of greater consequence on slowly permeable soils with long runs where water remains on the surface for long periods of time.

Length and Width of Irrigated Areas

The land area to be irrigated in a border strip or by furrows must be commensurate to the available or permissible irrigation stream. A reasonable amount of latitude can be exercised in the length and width dimensions and still retain approximately the design area.

Soil characteristics, dimension and slope of the field being leveled, the size of the irrigation stream available, crops to be grown and farm equipment to be used are factors that must be given consideration in choosing the design considerations.

Generally farmers are more interested in maximum length of runs rather than maximum area widths. Assuming a fixed irrigation stream, the maximum lengths are usually controlled by soil texture and water transmission characteristics. Runs can, of course, be shortened to allow for greater width of border strip or additional furrows.

Results from many studies indicate that runs should be limited to 300 feet or less on coarse-textured, freely permeable soils. On moderately permeable, medium-textured soils the lengths may range from 450 to 600 feet, while on the fine-textured, slowly permeable soils, runs of 600 to 900 feet may be used efficiently. Runs in excess of 900 feet may be justified on some very slowly permeable soils, where cropping systems generally require heavy irrigation applications.

Irrigation Stream Size

The basic principle involved in distributing water over a level surface is the simple hydraulic law that "water will seek its own level."

The design problem is to determine the proper stream size to apply to a given area to obtain coverage in the length of time allowable for a particular soil with particular water transmission properties.

The rate at which the soil will absorb a given amount of water must be given serious consideration at this stage. Intake rates of soils will vary from irrigation to irrigation, from season to season, with variations in soil-moisture content and with tillage practices and type of tillage equipment used. Condition of the soil surface, crop grown, and presence of residues are factors that affect the movement of water over level areas and must be considered in design. All of these factors are subject to change more frequently and are of a greater magnitude than is generally recognized.

Empirical Formulae

For these reasons the use of empirical formulae for determining irrigation-stream sizes on level irrigation is difficult. One must take into consideration all of the variables involved and establish a range of stream sizes to fit the conditions.

Where a fixed stream must be used, the design of the system should be such that the stream will be adequate

under conditions most often encountered. Ordinarily the design time for initial coverage will be from one-sixth to one-fourth of the intake time of the total irrigation if high distribution efficiencies are to be obtained.

Irrigation stream size has been studied with great care in some areas. It has been found that the minimum required stream size is generally proportional to the width of the area being irrigated.

An irrigation stream of 0.04 to 0.08 cubic foot per second per foot of border width has generally given excellent water distribution. A furrow stream of 30 gallons per minute in clean, well defined furrows, will afford good distribution with 36- to 40-inch row spacings with the lengths of run previously discussed for the various soil permeabilities.

Larger furrow streams are often desirable under certain tillage practices and conditions in furrow irrigation. However, the size of the furrow stream must be within the capacity of the furrow if crop damage may be incurred by flooding the ridges.

In cases where flooding the ridges is permissible or desirable, supplemental border ridges are used to confine the water to definite areas. These border ridges allow the use of larger irrigation streams and quicker application. But excessive stream sizes which create problems of soil scouring and soil transport should not be used. Fortunately, critical adjustment of stream size is not required to obtain a high efficiency with level irrigation.

Distribution Systems

The distribution system is the heart of a well designed level irrigation system. It must be capable of delivering the maximum required stream with an adequate safety factor. Erosion must be controlled and the labor required for operation and maintenance should not be excessive.

Where original land slopes are less than one per cent, design of field laterals and other features of the system for delivering water do not present problems greatly differing from those encountered in other irrigation delivery systems.

Unlined, open ditches are commonly used where benched areas of different elevations are not involved. Such ditches must be constructed so that adequate capacity will be provided with the water line well above the field being irrigated. This generally requires extra earth for ditch construction. The added efficiency in performance of a well-built ditch will more than compensate for construction cost.

Permanent turnout gates or siphon tubes are necessary to protect the ditch banks. Cutting ditch banks to outlet water provides poor water control and makes it difficult to apply the desired amounts of water. Soil is lost from the ditch banks and scouring often occurs. Unreliable ditches with increased costs for maintenance and irrigation labor often result.

Unlined ditches are not expensive initially but require more labor for each irrigation as well as continued maintenance. Irrigation water losses are greater from these ditches and they usually require more field space than pipe lines or lined ditches. However, if properly constructed, and maintained, unlined ditches can be used successfully.

Frequent drops in elevation that occur in benched areas require drop structures in open ditches or the use of closed conduits to eliminate erosion and control irrigation water. If the irrigation streams do not exceed three or four feet per second, underground pipelines are often less expensive than lined ditches. Portable pipe may be employed as field laterals where streams of two to three

CONTOUR bench systems are used on land where irregular slopes prohibit straight field benches. Water here is from underground pipes.

feet per second and less are used. Portable lines require more labor but their use may be justified until underground installations can be made or where few irrigations are needed each year.

Underground delivery systems with outlet valves for turnouts require the least labor for either maintenance or irrigation. Concrete is commonly used and is usually the least expensive underground pipeline. But cast iron, coated steel, plastic, and bituminous pipe are now available for such installations and may have advantages in a particular locality. The initial investment for an underground system is usually high. But the ease of operation and labor saving afforded the owner usually repays the added cost.

Basic Principles

Operation of a level system is simple, yet there are certain basic principles that must be followed for efficient performance.

On a graded system the water is usually in motion, but it may be moving or static on level systems. The depth of application on level land need not be directly dependent upon the time of application because it can be held on the surface until it enters the soil or is lost by evaporation. Hence the depth is not directly dependent on the time of application but rather on the irrigation stream size. Distribution is affected adversely by exceeding the maximum allowable time for initial coverage with level irrigation. Completely uniform application is approached as time of application diminishes.

An irrigation stream adequate to initially cover the area irrigated in the length of time allowed in the design of the system is a prime requisite to good water distribution. An average rate of advance of 10 feet per minute along the entire length of an irrigation run is a good rate of advance for irrigation water on level systems. If such a rate of advance is maintained on uniform soils, a satisfactory distribution of water will be obtained in the soil.

When the lengths of runs are established, the irrigator should not use any fixed size of irrigation stream as a criterion for good water distribution. He should use the length of time necessary for the water to reach the distal end of the run.

Determining Factors

Here again, soil texture and water transmission characteristics are determining factors. On fine textured soils the allowable time range is 60 to 90 minutes, on medium textured soils 35 to 50 minutes, while on the more permeable soils the time of initial coverage for an application of irrigation water should be 30 minutes or less. These time limits for initial coverage will generally be met where the lengths of runs and the irrigation stream sizes conform to the recommendations suggested elsewhere in this paper. However, if they are not met, there are three possible adjustments; namely, the stream may be enlarged, the width of the area may be decreased, or the length of the run shortened.

Many factors and conditions retard the rate of advance of irrigation water and make it necessary to adjust the size of irrigation stream to compensate for the retardance factors. Wind is a factor, as well as those connected directly with the land and the crops, which can affect the movement of irrigation water to a considerable degree. A wind velocity of 40 miles per hour not only stopped the advance of an irrigation stream, but actually reversed its direction for short distances during a level border irrigation field trial at Plainview, Texas on April 28, 1953.

Of all the factors connected directly with the land surface which inhibit or accelerate the advance of an irrigation stream, the roughness coefficient is possibly the most confounding. It is subject to extreme changes from irrigation to irrigation. The shape and size of the furrow and its degree of compaction or cloddiness change with almost every cultural operation. Good irrigators will take into account such factors when estimating stream sizes necessary for satisfactory rate of advance.

New operators also are generally concerned with forcing water through thick-growing pasture and meadow grasses. Experience has shown that level irrigation works well in such cases. It is necessary, however, in these cases to use a maximum stream and to build the border ridges considerably higher than borders used on graded land, or for crops which afford less resistance to the flow. Generally, it is well to have borders with an effective height of at least one foot, particularly near the irrigation turnout where the water is deepest during an irrigation application.

The excellent physical control of irrigation water afforded by level irrigation systems can lead to over-irrigation. A limited amount of water can be stored in the soil profile. Any over-irrigation is wasteful of water and can lower soil productivity of some soils.

Summary

Level irrigation as developed in the Southwest during recent years has provided farmers with a means of excellent control of irrigation water. This has resulted in improved application efficiency and more uniform applications of irrigation water. It has also reduced operation costs and thus increased the net income from the irrigated lands. It has made possible better land-management practices and contributed considerably to the permanency of irrigated agriculture in the areas where it is being used. This system of irrigation has a wide range of applicability and should be considered carefully by irrigation engineers who have the responsibility for designing irrigation systems.

Small Watersheds in the Program of the Soil Conservation Service

MELVILLE H. COHEE

Watershed work today, sponsored by local groups with assistance from the Soil Conservation Service, and other U.S.D.A. agencies, hinges on the Watershed Protection and Flood Prevention Act, Public Law 566, enacted by the 83rd Congress in August 1954, and amended in 1956 by Public Law 1018. First, however, let us examine some of the developments over the years which formed a base for the present happenings.

Consideration of watersheds in combating the damages of run-off water and in putting water to good use is not new. Some of the early work in land use and holding water in the U. S. A. before the turn of the century took some account of the watershed principles. By and large, however, multiple-purpose development of water resources has been done by river basins without regard to changes of runoff or sediment production resulting from land use and treatment.

INCEPTION of the soil and water conservation movement in the early 1930's was mainly around the soil phases. Individual farm units for the most part were planned and treated without regard to factors outside ownership boundaries. Good, progressive erosion control resulted; however, the off-farm flood and sediment damage problems have prevailed.

This new found farmer awareness of erosion and its practical control lead to institutional developments of great importance. Forward looking leaders in agriculture, and particularly in the Soil Conservation Service (SCS), appreciated that if the gigantic soil and water conservation job was to be done, its momentum must come largely from the farmers themselves.

They realized that land is real property, that farmers determine the ownership and use pattern of our agricultural lands, and, that real property is a responsibility of the several states. Farmers and professional agricultural leaders appreciated that a widespread, locally sponsored and directed attack should be made. Soil conservation districts came into being as a result. These are organized and operated under state laws.

Program Spreads

Organization and operation of soil conservation districts spread throughout the United States in roughly a 10-year period. As a result of their programs, the reductions in water run-off and soil losses were most gratifying to all concerned. At the same time, it was recognized that this type of approach, essentially farm by farm, was not enough to cope with all water and silt damage in the small watersheds. Soil conservation districts, therefore, have become sponsoring agencies for small watershed projects.

The needed watershed protection and flood prevention job is what the terminology implies. This is one of preventing floods from getting started. Flood problems begin where the rain hits the earth and where the snow begins to melt. It has been estimated by SCS that three-fifths of all the Nation's average annual flood damage takes place on the headwater streams. A large proportion of this damage is agricultural in small headwater valleys and it rarely makes national newspaper headlines.

On the average, 75 to 95 per cent of the agricultural flood losses in these headwaters are caused by floods that occur more frequently than once in 10 years. On the

CONSERVATION farming holds soil in place and reduces water run-off. Contour strip crops, terraces and waterways all play their part.

Melville H. Cohee is agricultural economist, Soil Conservation Service, 434 North Plankington, Milwaukee, Wisconsin. Reference illustrations are from the Cornbelt area but the principles apply over the entire nation.

FLOODWATER damages to highways and bridges run high in many small watersheds unprotected by a flood prevention program.

other hand, reduction of risk against major river floods expected only once in every 50 to 100 years is facilitated by work such as that of the U. S. Army Corps of Engineers.

Many forward looking leaders realized that there was a gap between the soil conservation districts' individual farm approach and the river basin development programs. As something of a prelude or pilot to Public Law 566, Congress in 1953 made an appropriation of 5 million dollars to start a new program of small watershed projects. It was an appropriation to be operative under Public Law 46. This is the law under which most of the SCS assistance is made available to soil conservation districts to further the planning and installation of on-farm land treatment measures. This "pilot" watershed work was undertaken through 58 small watersheds located in 34 states. The total cost of federal funds over an approximate 5 to 8 year period is expected to be around 29 to 34 million dollars with a like amount of non-federal contribution measured in labor, services, materials and cash. These projects were established as testing grounds. There have been some errors along with a large number of successful demonstrations.

Variety of Projects

The pilot watershed projects located in the Corn Belt Area range in drainage area size from 8,000 acres to 204,000 acres. There is wide variation in principle content and type of installations among the projects. Some have only minor structural works but call for an intensification of land treatment. The majority of the watershed projects, however, have considerable special watershed protection and flood prevention practices in addition.

There are some basic principles and concepts which guide the watershed approach as executed under leadership of the Soil Conservation Service. These principles and concepts, widely tested in the pilot projects prevail today in the work under Public Law 566 as first passed and as now operative with amendment Public Law 1018. In considering them it should be kept in mind that soil conservation and water conservation are inseparable.

Two fundamental principles are behind any pilot or Public Law 566 watershed project. These are clearly presented by D. A. Williams, Administrator, SCS, as: *"One is the principle of local initiative and responsibility in starting a watershed development project, planning and carrying out the land treatment and structure work, and maintaining the work. Small watershed development is not a Federal dam-building program.*

*"The other fundamental watershed principle is that conservation land treatment for soil erosion control and water management is the backbone of any watershed protection and flood prevention undertaking. That is why it is required by law that at least 50 per cent of the agricultural land above any structure that may be necessary for floodwater detention or water conservation be planned for conservation land treatment."**

Federal Cooperation

This first basic principle is reflected in the opening preamble of Public Law 566, as Amended by Public Law 1018, in these words: ". . . it is the sense of Congress that the Federal Government should cooperate with states and their political subdivisions, soil or water conservation districts, flood prevention or control districts, and other local public agencies for the purpose of preventing such damages and of furthering the conservation, development, utilization, and disposal of water and thereby of preserving and protecting the Nation's land and water resources." The Act continues, in Section 2, to limit its application as to the size of watershed or subwatershed areas and in regard to structures therein, as "not exceeding 250,000 acres and not including any single structure which provides more than 5,000 acre-feet of floodwater detention capacity, and more than 25,000 acre-feet of total capacity." Furthermore, it is provided that, "No appropriation shall be made for any plan involving an estimated Federal contribution to construction costs in excess of $250,000, or which includes any structure which provides more than 2,500 acre-feet of total capacity unless such plan has been approved by resolutions adopted by the appropriate committees of the Senate and House of Representatives; . . ."

In the small watersheds, works of improvement on one tributary can be related to that on another, on one farm to another, and all related to the network of channels carrying excess water safely through the fertile, alluvial flood plains. Perhaps more important is the fact that

*"Our Broadened Farm and Watershed Conservation Job"—Remarks by D. A. Williams, Administrator, SCS, Sept. 15, 1956—at Mazeppa, Minn.

owners and operators of lands affected and the people in small cities protected or interested in stabilized water supply, work together in their joint effort. These same people are a part of the local organizations which sponsor the watershed project and assist in its planning and execution. Thus far all Public Law 566 watershed applications for assistance in the Corn Belt Area have been sponsored by one or more soil conservation districts either singly or with co-sponsors such as counties, cities, conservancy districts or similar agencies.

In eight of the Corn Belt states the first 18 projects receiving planning help from SCS under Public Law 566, range in size of area from 3,100 acres to 159,000 acres. Ten are less than 25,000 acres each, while 2 are over 100,000 acres. Many different circumstances enter into local considerations which finally determine the area to be sponsored in a single application for assistance. Perhaps two stand out: (a) the physical conditions affording the problems and their possible solutions; and (b) the interest, understanding, willingness and abilities of local people to work together in installing a worthwhile watershed program.

Community Endeavor

The second basic principle (that the land treatment phase of the tributary watershed development is the backbone of the total undertaking) also has a big relationship to this concept of community type endeavor. Experiences gained in somewhat larger watersheds dictate that installations go forward by sub-watersheds. In such smaller watersheds the people move on their land treatment work with a decided commonness of purpose. They understand why terraces, small check dams, grassed waterways, and other applicable measures must be installed to hold back water and keep soil in place before the water detention or stabilizing dams are built. One farmer prompts another to move along with his individual farm conservation program and not hold up the sub-watershed program. The people appear to appreciate that if the land treatment work is done, smaller and less costly dams can be built and their useful life will be longer.

Evaluate the Plan

Good watershed programming is, first, to evaluate what the land treatment will do, and, second, to plan for dams and other structural measures that will care for the remainder of excess water and sediment insofar as it is economically feasible to do so.

Floodwater and sediment damage reduction measures are truly fitted to a combination of three major considerations: (1) hold as much water as possible where it falls; (2) install dams to hold back water and trap sediment; (3) do stream and channel work to help carry the water on through the alluvial flood plains with the minimum over-bank-flow stages. The extent of installations of each of these categories of work, separately and in combination, is determined by careful planning with the local people and by testing alternate combinations of measures both from a physical and an economic cost-benefit approach.

The Watershed Protection and Flood Prevention Act states that the Secretary of Agriculture, in order to assist

DAMS are usually necessary to supplement conservation farming land treatment when providing flood protection for a watershed. A complete program is both practical and permanent. Drawing by Felix Summers, the JOURNAL'S contributing artist.

local organizations in preparing and carrying out plans of improvement, is authorized to do five things:

(1) conduct such investigations and surveys as necessary to prepare plans for works of improvement,

(2) prepare plans and estimates required for adequate engineering evaluations,

(3) make allocations of costs to various purposes to show the basis of such allocations and to determine whether benefits exceed costs,

(4) cooperate, enter into agreements, and furnish financial and other assistance to local organizations,

(5) obtain cooperation and assistance of other Federal agencies in carrying out the purposes of this part of the Act.

The third item above prompts the economic appraisal in the watershed work plan.

In making determinations as to whether benefits exceed costs, SCS makes those studies necessary to evaluate the watershed damages and benefits "with" and "without" the proposed project program. The project justifications are developed on the basis of incremental benefits and costs for each of the separable segments. The benefit-cost analyses employed are based on primary monetary benefits. The cost of planning services and technical assistance is not included in the benefit-cost analysis. All other monetary outlays made and goods and services —including installation services by various interests such as the initial installation costs, major replacements, and operation and maintenance costs—are included in the benefit-cost analysis. Furthermore, any induced costs, such as uncompensated adverse effects caused by construction or operation of the project, are also included if measurable in monetary terms.

Land-treatment measures are not supported by funds under Public Law 566 in their installation costs. Therefore, these are not included in general benefit-cost ratio calculations. As pointed out earlier, justifications for all other measures for inclusion in the project are made on the assurance that the land-treatment measures in the watershed work plan are to be installed.

The benefits included in the economic analysis of watershed protection and flood prevention measures (not including land treatment measures), may be covered in eight groupings. To prevent any misunderstanding of the following statements, perhaps it should be repeated here that only primary benefits figure into the benefit-cost analysis regarding economic justification.

First, there are the benefits from reduction in direct and indirect damages from floodwater and sediment. This would include damage to crops or pastures, fences, roads (public or private), bridges, and communication facilities. Also loss of livestock and stored crops, damage to land from erosion or infertile overwash, loss in water storage capacity in existing reservoirs, damage to rural buildings and damage to all types of urban properties and facilities. Reduction of any one or all such damages becomes a benefit once the program is in effect.

The second consideration among the six groupings, can be listed as increases in net income from changed use of property made possible as a result of reduction in the flood hazard.

A third type of benefit can be stated as on-site increases in net income from additional production or reduced production costs on lands on which measures are installed.

A fourth type of benefit may come about as an increase in net income from additional production, or reduced cost of production, of farm products.

FIELD crops may be extensively damaged by flood waters and deposits of sediment. Yet, most of these damages could be prevented with an adequate watershed program.

DAMS that hold back excess water in small watershed areas may prevent much damage below. Basins are usually low value lands.

REPAIR costs on secondary roads and bridges may run high on small unprotected watersheds. Most such damage can be prevented.

A fifth type of benefit may be listed as savings in the cost of water treatments resulting from reduction of sediment in industrial, municipal, and domestic water supply.

A sixth benefit is the value of municipal and industrial water supply to be furnished.

Another is the increase in value of recreation, fish, and wildlife resources expected from storage capacity specifically incorporated for the purpose of creating such values.

The last benefit in this group of eight is listed as other benefits that can be evaluated in monetary terms.

The current policy of the Secretary of Agriculture pertaining to administration of the Watershed Protection and Flood Prevention Act sets forth a number of extremely crucial points regarding benefits, among which are the following:

1. "Costs shall be less than primary benefits. Benefits are to be assessed with care and are to be clearly creditable to the improvement. Secondary and intangible benefits should not be used for economic justification but may appropriately be used as argument for project justification or proposals for establishing equitable cost-share arrangements."

2. "Funds available under authority of the Act will provide only for works of improvements producing direct measurable benefits to groups of landowners, to communities, and to the general public."

3. "It is the policy of the Department that the local organization will assume that part of the installation cost of structural works of improvement allocated to the agricultural phases of the conservation, development, utilization, and disposal of water which is equal to the ratio of direct identifiable benefits to total benefits produced by such works of improvement. The local organization will not be required to assume any part of the construction cost or cost of engineering services for structural works of improvement allocated to flood prevention. The local organization will be required to assume all installation costs, including engineering services costs, for purposes other than flood prevention, and the agricultural phases of the conservation, development, utilization, and disposal of water. Where a single work of improvement is planned to serve more than one purpose, an allocation of costs to each of the purposes shall be made, and the local organization shall bear its share of the costs allocated to each purpose in accordance with the foregoing criteria."

4. "If the costs allocated to the local organization for the agricultural phases of the conservation, development, utilization, and disposal of water on the basis of direct identifiable monetary benefits appear inequitable in consideration of intangible or other public non-measurable benefits, such benefits will be taken into account in reaching agreements on cost sharing, but in no event will the Federal share of the cost exceed the equivalent Federal assistance available for other similar project-type programs. Direct identifiable benefits are those benefits accruing to individuals or organizations that would normally be required to pay special assessments or taxes for such benefits."

5. "Works of improvement, including both land-treatment measures and structural measures, as may be needed for flood prevention or the conservation, development, utilization, and disposal of water will be planned for all lands within a watershed regardless of their ownership."

Interpretation of a few terms involving benefits assumes key importance in arriving at project justification and cost allocation. Brief definitions as followed over past years are in order.

Primary benefits are the value of immediate products or services resulting from the measures installed. They may include both direct and indirect benefits.

Secondary benefits are the values added over and above

the value of the immediate products or services of the project as a result of activities stemming from or induced by the project.

Project costs are the value of goods and services required for establishment, maintenance and operation of project measures.

Benefits are defined as all identifiable increases or gains in assets or values, whether in goods or services, or intangibles, whether primary or secondary, and whether measurable in monetary or non-monetary terms. As applied to a project, they are determined after taking account of conditions with and without the project and are net above all costs other than project costs.

Project Data

To illustrate benefits, costs and other considerations covered in this paper, certain data for a project are presented. This watershed project has an area of about 18,000 acres (28.16 square miles). Without the proposed program there are 4,850 acres of rotation cropland and with the program 5,600 acres; grassland will increase and woodland areas will decrease. Around 70 per cent of the cropland is in the flood plain of the watershed. Average annual rainfall is 42.5 inches. Without the project, average annual floodwater and sediment damages amount to roughly $12,000 and with the project $2,500. In addition, changed land use made possible by reduction of the flood hazard wil account for added average annual benefits of nearly $7,000. Also, increases in average annual net income from lands on which drainage measures are installed amount to roughly $8,000.

The average annual benefits of all types measured in dollars, amounts to a total just under $26,850 for this watershed project. Of these benefits 68 per cent are a result of structural measures designed to prevent floodwater and sediment damages, and 32 per cent agricultural water management benefits—in this instance drainage. The land treatment phase of this project, which does not enter into benefit-cost analysis, increases the project benefits by approximately three percent; in this particular watershed the upland land use already reflects a high level of management.

The average annual costs of this project, that figure into the benefit-cost analysis, total $13,300. The average annual drainage benefits part is $8,000 with average annual costs of $4,900, giving a benefit-cost ratio of 1.6 to 1. The flood prevention part from structural measures accounts for the balances with a benefit-cost ratio of 2.1 to 1. Total construction costs for this project are just over $227,000 of which roughly $61,000 is for drainage. Land treatment costs, not entering into benefit-cost analysis and not supported by Public Law 566 funds, have an estimated cost of just over $110,000, exclusive of technical assistance costs.

Including all installation services, technical assistance, construction costs, land treatment costs and otherwise for doing the entire protection and flood prevention job called for in this watershed work plan, the estimated grand total expenditure is $464,000. Although all parts of this cost are not analyzed as to extent of benefit-cost ratio, study of the project indicates that all concerned are making a safe investment. The possible average annual returns will be at least double average annual costs.

The landowners and operators in this project are anxious to carry out their fair share part of the watershed program costs. All land-treatment measure costs will be their responsibility as well as that part of the non-flood prevention installation costs determined in accordance with the policy principles referred to earlier. Although intangible benefits are not discussed herein, they may become a consideration for project justification or proposals for establishing equitable cost-share arrangements.

Land easements and rights-of-way necessary to the installation of proposed works of improvement must be provided by the local sponsoring organization for a Public Law 566 watershed project. Also, adequate operation and maintenance of such works is provided by that organization. Furthermore, the local people must acquire or provide evidence that landowners as water users have acquired, in accordance with any applicable state laws, such water rights as are needed in the installation and operation of works of improvement called for in the watershed work plan.

As pointed out earlier, the Department will bear the construction costs and engineering services costs for structural works of improvement for flood prevention.

Summary

In summary, one can say that in the small watersheds part of the programs of the Soil Conservation Service, appraisal and evaluation work leading to watershed work plans must be done with care and diligence. It involves many technical aspects—hydrology, geology, soil survey, economics, engineering, agronomy, forestry, and biology, only to mention some of those outstanding. The behavior of water and its use and its effects on soil and soil movement with and without improved watershed protection and flood prevention works of improvement have many ramifications.

All of these must be considered in their interrelationships to make evaluations useful as a basis for fair and equitable distribution of costs between Federal and non-Federal interests.

One fundamental point is outstanding. The basic element of watershed programs is the conservation treatment of all the land in the watershed. Engineering structures must be supplemental in purpose, even though essential in the ultimate solution of most water problems.

Factors Affecting Evaporation from Plants and Soils

C. B. TANNER

Evaporation of water from a plant or soil surface is caused by heat. This is generally known. But factors that affect the amount of evaporation and transpiration are not so well understood. In this paper, the author discusses some of these factors and the manner in which they operate. There are interesting implications for both farmers and conservationists.

EVAPORATION from a plant or soil surface is caused only by heat. Every acre-inch of water that evaporates consumes about 240 million British thermal units (BTU) of latent heat. The factors that affect the amount of water that evaporates are of two general classes: (1) those that affect water supply (or heat sink) at the evaporation surface, and (2) those that affect heat supply to the surface.

In agriculture, the water supply is that stored in the soil and replenished by rainfall and irrigation. The heat source is principally solar radiation, though some heat may be derived from the air. To facilitate the discussion we will consider the exchange of heat at the evaporation surface and then consider three surfaces—a bare soil surface, a surface completely covered with vegetation, and a partially covered soil surface.

Heat Supply for Evaporation

The heat available for evaporation comes primarily from solar radiation that arrives at the earth's surface.

Some figures for Wisconsin indicate the magnitude of the solar heat. During the six months of April through September, the average incident radiation at Madison, Wisconsin, carries sufficient heat to evaporate about 55 inches of water—nearly twice the average annual precipitation. Fortunately for Wisconsin's water supplies, part of this radiation is reflected from the earth's surface and part is re-radiated as shown in figure 1.

Net radiation, the difference between incoming and outgoing radiation, is the heat *available* for evapo-transpiration (i.e. evaporation from soil and transpiration from plants). During the daytime, part of the net radiation usually goes into heating the air (sensible heat), a small amount goes into heating the soil and vegetation, and the remainder goes into evapotranspiration as illustrated in figure 2. As the soil becomes drier and the water supply in the soil becomes less available, less of the net radiation is used in evaporation. Consequently, the surface temperature rises, and there is a greater transfer of heat from the hot surface to the air.

At night the surface cools by radiation, as shown in figure 3. Evapotranspiration usually continues at night, and for a cropped surface is about 5 to 10 percent of the daytime value. The outgoing nighttime radiation is about 10 percent of the daytime net radiation. The heat supply at night for evaporation and radiation comes from the soil, vegetation, and from the air. When dew (or frost) forms at night, this latent heat is converted to radiation and helps prevent further cooling of the air and the surface. Over a 24-hour period, the soil heat losses at night about equal the daytime gains.

When the surface is very moist, it may be cooler than the air so that heat is transferred from the air to the

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Figure 1

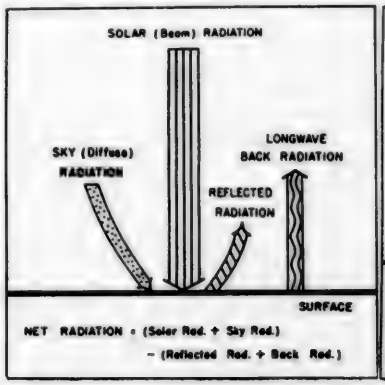

SOLAR (Beam) RADIATION
SKY (Diffuse) RADIATION
LONGWAVE BACK RADIATION
REFLECTED RADIATION
SURFACE
NET RADIATION = (Solar Rad. + Sky Rad.) - (Reflected Rad. + Back Rad.)

Figure 2

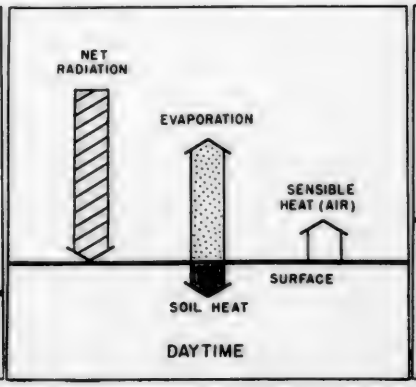
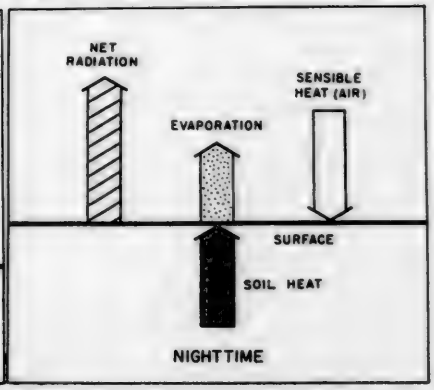


Figure 3



surface as shown in figure 4. An extreme case of this kind of heat exchange is exemplified by the wet bulb thermometer which derives all the heat for evaporation from the air. In this instance the evaporation exceeds the net radiation.

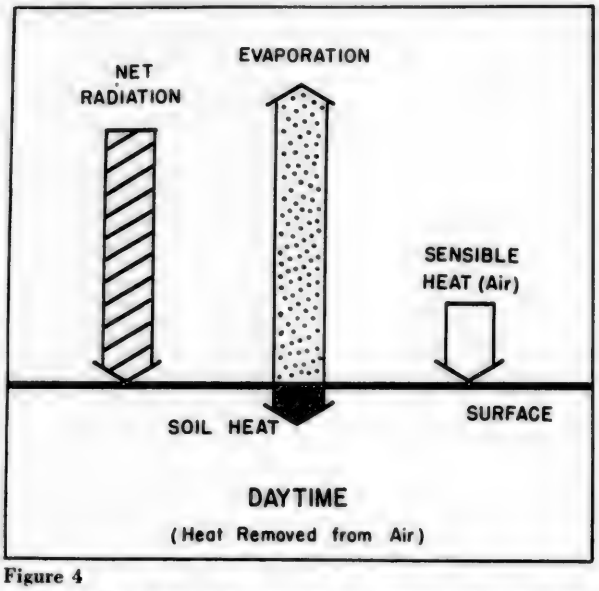


Figure 4

Figure 5 is a scatter diagram of evapotranspiration vs. net radiation for an irrigated alfalfa-brome-ladino hayfield. All points above the line are for days similar to those illustrated in figure 4 in which evapotranspiration exceeded net radiation. Points below the line correspond to figure 2 in which part of the net radiation was converted to sensible heat. Figure 5 shows the high correlation between evaporation and available heat when moisture at the plant surface is plentiful. When the hay was cut, there were a few days during which the soil was exposed and there was little leaf area. As shown in figure 5 for these days, less water was available at the surface and a large portion of the net radiation was converted to sensible heat rather than to evaporation.

The data in figure 5 also illustrate the amount of evaporation produced by "hot, dry" winds in Wisconsin. The greatest amount of heat derived from the air, as opposed to the heat derived from radiation, in one day during the summers of 1955 and 1956 was on July 9, 1956, and accounted for less than 25 percent of the total evaporation that day. It is to be emphasized that, in humid regions and parts of the subhumid regions, heating from the air accounts for a relatively small portion of the evaporation as compared to radiation even with well watered crops.

In arid regions, irrigated fields are surrounded by very dry areas where most of the net radiation goes to heating the air. The temperature difference between this heated air and the irrigated crop surface may be much larger than that in humid and sub-humid regions. Thus, more heat for evaporation may be extracted from the air over the crop. This heat exchange is increased when the temperature difference between the evaporating surface and the air becomes greater and also when the turbulence of the air over the surface is increased. The turbulence increases with increasing wind speed and surface roughness. For example a cotton field with widely spaced plants will be a rougher surface than an alfalfa field, and heat exchange from the air will be greater. On the other hand, a dense corn or grain field is not much different from an alfalfa field. The exchange of heat whereby air *over the crop* is cooled to supply heat for evaporation is called the "Oasis effect" by some workers.

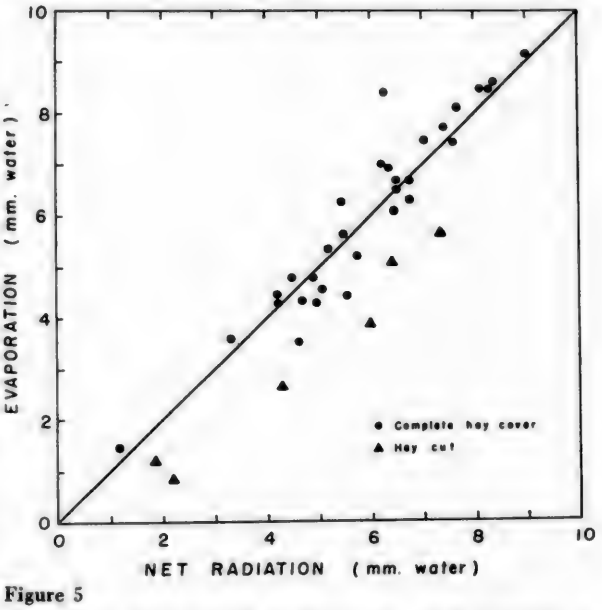


Figure 5

There is one situation in which very large amounts of evaporative heat is supplied by the cooling of warm air. This is at the border of a well watered field where warm air from off the field moves *through* the crop. At the border of the field on the upwind sides, the whole transpiring leaf area of the crop is presented to the warm air *moving through* the crop. The heat exchange here is much greater than in turbulent exchange *from above* as discussed previously. We will call this the "clothesline effect", which is an identical situation as illustrated in figure 6. Also illustrated in figure 6 is turbulent exchange from above. In a large field with reasonable planting density, the air moves only a few yards into the crop (many agriculturists have experienced the low air movement in the center of a large corn field). Consequently, in large fields the increased water loss from the field due to the border "clothes-line effect" is relatively small. However, in small test plots, the whole plot is subject to the "clothes-line effect." Thus, under the same climatic con-

ditions, the daily evapotranspiration from a 16 x 60 foot corn plot, which is open to air movement throughout, may be much greater than from a hay plot of the same size even though in a large field of corn it will be about the same as in a large field of hay.

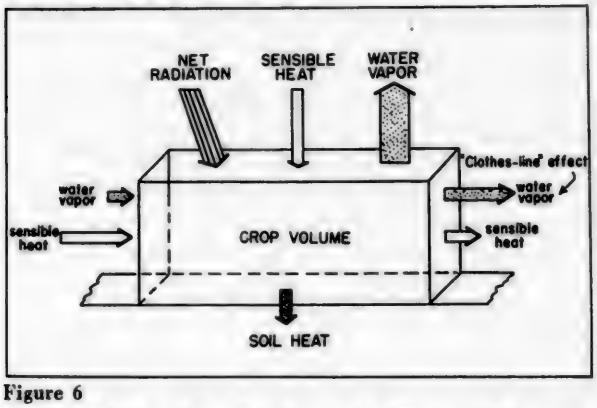


Figure 6

This "clothes-line effect" can be illustrated by some data from 2.4-foot diameter lysimeters at Madison, Wisconsin, during the first two weeks in August, 1950 (Moldenhauer, 1951). The evapotranspiration from reed-canary grass in lysimeters surrounded by mowed grass represented 2.2 times the net radiation. Thus, the heat derived from the air was greater than from the radiation. This may be compared to the data given earlier for a hay crop on an extreme day in which only 25 percent of the total evapotranspiration was derived by cooling the air. If the lysimeters had been planted to a corn crop, the relative amount of heat extracted from the air would have been increased further because of the increased transpiring surface presented to the wind. This is a result only of the small area and does not indicate moisture use on a field basis.

When small plots, lysimeters, etc. are employed, they should be "guarded" for some distance by a crop of identical size, maturity, and moisture conditions. When moisture or fertility variables are inserted in an experimental field, they often introduce different crop heights on the different areas, and the "clothes-line effect" will cause different amounts of evapotranspiration on these areas. The usual small plot and lysimeter layouts, and also experimental strips across a large field, *cannot be used to obtain evapotranspiration data representative of a large field.*

Evaporation from Bare Soil

Evaporation from a free water surface is limited only by the heat available. It is higher than from other surfaces which have a more limited water supply. Evaporation from a very wet soil may approach nine-tenths that from a large free water surface (Penman, 1948).

When a well drained soil profile is wetted to field capacity, the initial evaporation is largely limited by the heat transfer to the surface. As the surface dries, less of the net radiation goes into evaporation and the surface temperature rises, heat is transferred to the air, and the air temperature rises. In this instance, the moisture availability rather than heat supply is limiting evaporation. The soil below the surface may be moist, but moisture transport to the surface by capillary movement is slow. There is, of course, some water vapor movement from the soil body to the surface, but the amount of water lost by vapor diffusion from the soil has relatively little agricultural significance except at the surface layer. Richards, *et al.* (1956) reported some measurements of water movement within the profile of a bare soil under conditions of a high daily heat load. They found that the total water content in the profile to any given depth varied as a power function of the time, so that a log-log plot of total water to a given profile depth against time was linear (see figure 8 for an example). They also found during the 59 days of their experiment that vapor transfer of water had no agricultural significance. They show that evaporation from the soil can be calculated with reasonable accuracy from intrinsic soil properties and the measurement of suitable hydraulic boundary conditions.*

When there is a water table close to the surface, capillary movement will be much greater than in a deep, well-drained soil. Figure 7 illustrates annual evaporation from bare soil with different depths to the water table (plotted from data by Viehmeyer and Brooks, 1954). It should be noted that the Class A pan evaporation is larger than evaporation from a larger body of water. If the pan is corrected by usual coefficients, the evaporation for a large free water surface would be in the range shown. The evaporation from soils with shallow water tables could be found from intrinsic soil properties and hydraulic boundary conditions. In this instance the knowledge of the heat transfer at the surface implements the solution of the evaporation equations.

Evaporation From a Complete Vegetative Cover

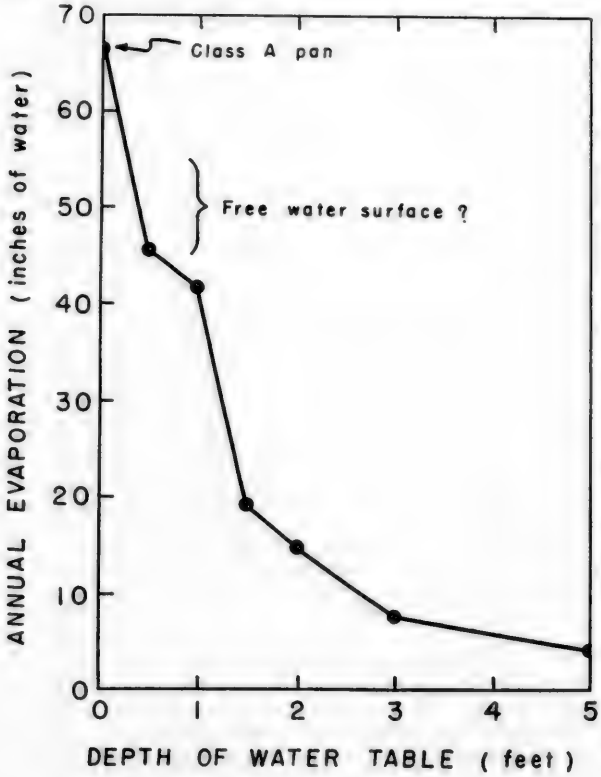
A complete vegetative cover intercepts almost all of the radiant heat and the evaporation from the soil is small compared to that from the plant surface. Transpiration, like evaporation from soil, is dependent upon the water and the heat available. Since the water supply of the plant is the soil water, we can view the plant as a coupling—a transducer—between the soil and atmosphere. The availability of water at the leaf surface is governed (a) by the availability of soil water at the plant root surfaces and (b) by the impedance to flow through the plant.

The availability of water at the root surfaces is affected largely by the magnitude of the root system (i.e. the vol-

*For other discussions on water loss from soils see Lemon (1956) and Hide (1954).

ume of soil in which the roots have proliferated and the spacial density of the root proliferation) and the content of soil water. The content of soil water influences the availability mainly through its effect on the capillary flow to the root surface. If the soil water content is high, water flows readily to the root surface to replace water taken up by the plant. When the soil water content is low, the movement of water to the roots is low and will not meet the "evaporative demand" (or heat load) at the leaf. In this instance, large moisture stresses develop at the plant root surface. These stresses are reflected at the leaf by loss of cell turgor and decrease in stomata aperture. The amount of available water in soils (excess over the wilting percentage) and soil moisture stress (averaged over the soil volume containing roots) have been useful in characterizing soil moisture availability. However, these are, respectively, a "capacity" and "intensity" factor which are not fully descriptive. A "rate" factor of moisture supply is also needed. "Temporary" wilting is commonly observed on days of high heat load even though substantial "available water" remains at measured moisture stresses less than those usually associated with plant wilting. This is an example of the effect of low capillary flow to the root that fails to supply water equal to the heat load on the plant. The supply of water and the measured stress fail to indicate both the low rates of movement and the high stress that *occurs at the root surface.*

Figure 7



The effect of the flow impedance of the total plant, including the effect of stomatal aperture, is even more obscure than impedance from soil to plant. However, it is generally believed that the impedance to water movement within the plant from the root surface to the leaf cells is less than in dry soils to root and is certainly less than the impedance encountered in the vapor diffusion path from the leaf cells through the intercellular spaces, the stomata, and the still air film about the leaf (Honert, 1948). In fact, Honert indicates that only at small stomata aperture do aperture changes greatly affect transpiration, and that most of the impedance is in the vapor diffusion through the still air film at the leaf surface. Stomata aperture depends upon the turgor of the guard cells which, in turn, depends upon the soil moisture supply and stresses at the root surface, the flow impedance of the plant, and starch and sugar content of the cells (the latter is associated with stomata aperture changes from day to night). Certainly, there are differences in the physiological adaptation of some plants (e.g., sorghum and desert plants) to dry regimes that include mechanisms for retarding transportation. E. R. Lemon (unpublished data) has shown that the stage of maturity of the cotton plant can affect transpiration at relatively high soil water contents. Other crop plants may have a changed response at different stages of growth.

Even though there is a possibility of large differences in the physiological response between different plant species that may affect the flow impedance, the transpiration from many plant species is the same under equal evaporative conditions *provided the "evaporative demand" does not exceed greatly the soil moisture supply.* This means that ample water must be present at the root surface (by virtue of a large root system or high soil moisture) or that the heat available for evaporation is small.

Aaltonen (1945) found that from March through December (1934) and particularly March through June, when soil water was abundantly available, the soil moisture loss in the top three feet of soil in adjacent areas of meadow and scotch pine were the same.

Zahner (1955) found that the rates of soil water depletion were the same under 35-year stands of southern red oak, post oak, and black jack oak and stands of 20-year-old loblolly and short leaf pine. An earlier sampling by Moyle and Zahner (1954) showed that the amount of water removed by an even-aged hardwood stand, all-aged hardwood stand, and all-aged pine stand was the same over the same period.

Danish Experiments

In Denmark, Aslyng and Kristensen (1933) found that the evapotranspiration from fields of wheat, oats,

clover-grass and alfalfa during the same periods of the growing season was nearly the same regardless of crop size or variety. Evapotranspiration from Swedes and fodder sugar beets was less than from the cereals and forage crops in the early part of the season because of the greater exposed soil surface (less vegetative cover). But as growth proceeded and the tops effectively covered the soil, evapotranspiration from the former increased to a value slightly above cereals and forages (the latter were under higher moisture stress and water was somewhat limited late in the season).

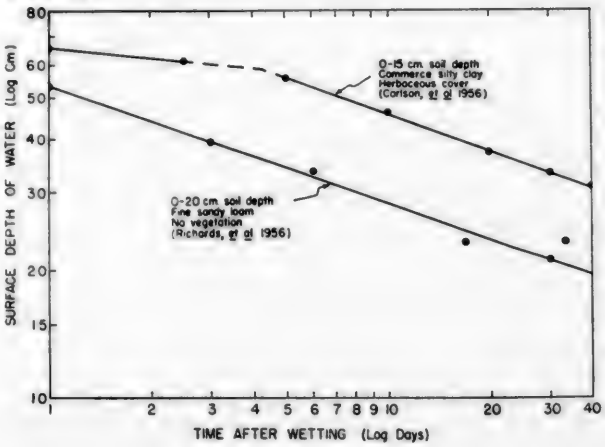
Two well conducted experiments (Aslyng and Kristensen, 1953, and Hagan and Peterson, 1953), the former in Denmark and the latter in California, demonstrated that the evapotranspiration from clover-grass mixtures and alfalfa was not influenced appreciably by the frequency of cutting, which would affect total leaf area.

Evapotranspiration Depends on Heat

The above data indicate that evapotranspiration rates from green crops are dependent mainly on the heat available (climate) and are not generally dependent upon type of vegetation, provided soil moisture is adequate. The differences in evapotranspiration rates between types of crops as usually reported are due to (a) the extent to which the soil is covered by the vegetation, since evaporation from a dry soil surface between crop rows is less than transpiration (b), to differences in soil moisture availability, including the character of the crop root system (since a deep rooted crop has access to a larger moisture supply in dry years, the transpiration rate from the deep rooted crop will exceed that from a shallow-rooted crop in dry years during periods when water is less available to the shallow-rooted crops), and (c) to the differences in heat exchange, particularly the "clotheslines effect", that may exist between different crops when small plots are used.

In addition, results are often expressed as cumulative evapotranspiration during the growing season which is dependent upon the length of the growing season as well as extent of cover and rooting depths. Most evapotranspiration data for crops are given for the growing season under conditions where water is limiting and also for small plots. These types of data obscure the important fact that evapotranspiration *rates* (i.e., the evaporation over the same period) are the same for many different vegetal types provided (a) there is complete cover, (b) that soil water is available, and (c) that the crops are subjected to the same heat load (climate).

Figure 8



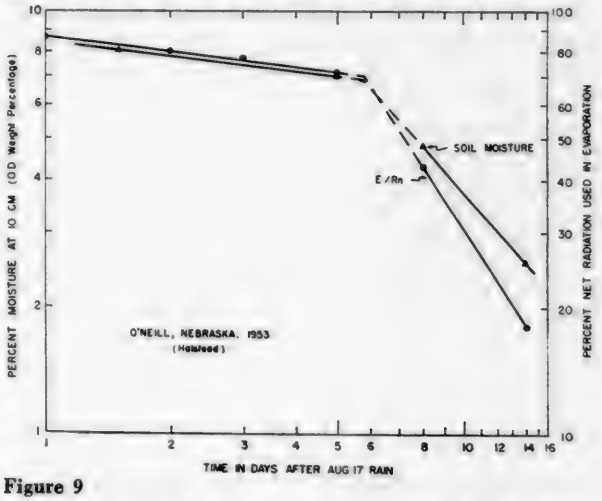

PERCENT MOISTURE AT 10 CM (OD Weight Percentage)
PERCENT NET RADIATION USED IN EVAPORATION
SOIL MOISTURE
E/Rn
O'NEILL, NEBRASKA. 1953
(Halstead)
TIME IN DAYS AFTER AUG 17 RAIN

Figure 9

In figure 8 the water content changes in the upper 20 cm. of a bare soil in California (Richards, *et al.* 1956) are compared to the water content changes in the upper 15 cm. of a soil in Mississippi with herbaceous cover (Carlson, *et al.* 1956). In figure 9, data are presented of the soil water content changes at the 10 cm. depth of a sandy loam in Nebraska planted to Blue Gramma (Halstead, 1954). There is a striking similarity between a bare soil and a soil covered with vegetation during the latter period of water loss as if the movement of water through the soil to the plant roots controlled transpiration. The flatter portion of the curve during the first period of water loss from the soil covered with plants may arise from the root distribution of the plants which obtained water from other parts of the profile. Of particular interest is the similarity between the soil water curve in figure 9 and the percent of net radiation used in evaporation.

These data are presented in different form in figure 10. Apparently in this instance, the water content at the 10 cm. depth fortunately represented the mean condition for the entire root system. Figure 10 illustrates the interaction of available heat and available water. When water content is high most of the net radiation is used in evaporation. As the soil moisture decreases below a certain range, the water becomes less available to the plant

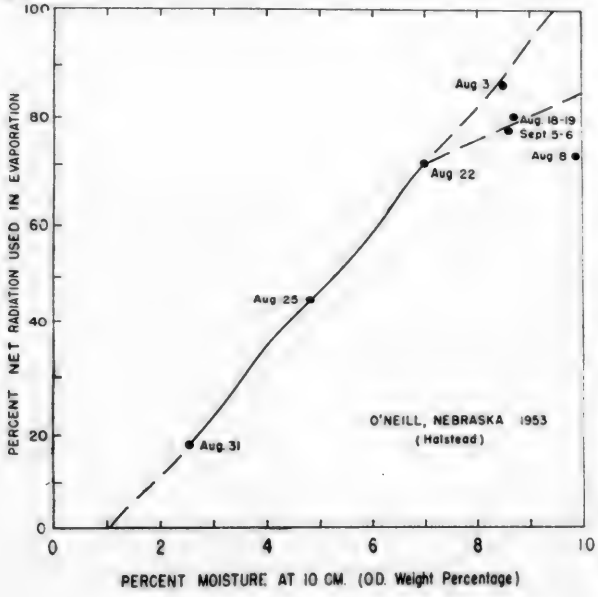
and results in a marked decrease in the stomata apertures and other possible physiological changes that limit transpiration. Consequently, more of the net radiation is converted to sensible heat and less to transpiration. This action progresses with a continuing decrease in soil water content and transpiration, and also a decrease in the conversion of net radiation to transpiration.

Evaporation From a Composite Surface

When plants are grown at a low population per unit area, only part of the radiation is intercepted by the plants so that the soil surface receives considerable heat. Except for short periods following either rain or irrigation, only a part of the radiation striking the soil is used in evaporation—most of it is converted to sensible heat. Thus, soil water is conserved in comparison to a complete crop cover. The evapotranspiration from a composite suface will be between the extremes of bare soil and a complete cover of the specific crop. Little work has been done on the heat exchange of this type of surface which is much more complicated. However, the energy aspects would indicate that the *lowest possible* evapotranspiration could be found by estimating evaporation for the area of bare soil receiving *direct radiation* (not shaded by the plant) and estimating transpiration for the remaining area as if it were a complete crop cover.

Actually the evapotranspiration on a composite surface will always be higher than this minimum estimate, and at times may approach a full cover crop, even though substantial portions of the soil are not shaded by the crop. This may be possible for two reasons: first, nearly all the net radiation at the soil surface that does not go into evaporation, heats the air. This heated air in the crop volume may transfer substantial amounts of heat to the crop, increasing the transpiration. Second, a low population crop is more open to the wind, so that heated air from surrounding areas can move through and provide heat for transpiration. This "clothes-line effect" can be substantial depending upon the crop height. In addition, the surface roughness is increased by sparse planting which promotes turbulent transfer of heat to the crop from above. In general, low population planting is practiced in dry regions where water conservation is required. In these regions, a large part of the radiation converts to sensible heat and the air temperature is frequently higher than crop temperature so that heat transfer from the air to the crop may be appreciable.

Figure 10



Summary Remarks

The three factors that affect evapotranspiration from crops planted in large fields, in order of their importance, are (a) the climate (heat available from solar radiation and the air), (b) the soil moisture availability (capillary conductivity of the soil, soil moisture stress, and soil water content), and (c) the physiological reaction of the plant to the difference between the moisture availability and the "evaporation demand".

When soil moisture is available to the plant (a desirable situation), the evapotranspiration varies daily with the daily climate variation. The daily evapotranspiration is constant only when the climate is relatively constant. An important fact to remember is that the average evapotranspiration for an individual day or month (as in average consumptive use figures) represents the actual daily evapotranspiration no more accurately than the average precipitation is representative of any individual day or month. This use of "average" is like the man standing with one foot in ice water and the other in hot water. As an average one might say he was comfortable.

The recognition that the evaporation is dependent to such a large extent upon solar radiation, and that the heat available from the air is usually not large and is about the same for different crops planted in large fields at reasonable densities, leads to several interesting and important conclusions regarding the effect of plant population and soil fertility upon evapotranspiration, and also regarding the effect of dew and intercepted water.

If a crop is planted at a low population, the evapotranspiration will be low because there is less transpiring surface to which heat is transferred and the evaporation from the exposed soil is less than from plants. If plant population is increased, evapotranspiration will increase until a good soil cover is provided. Further increases in population will not cause an appreciable increase in evapotranspiration, since the evaporating area receiving the radiant heat is not increased. Some of the plants or parts thereof will stand in the shade of other plants or parts. On a field basis, the height of crop affects the

evapotranspiration very little since the plant area intercepting radiant heat is not changed appreciably. Thus, one should not expect the water needs of a 200 bushel corn crop to markedly exceed that of a 100 bushel crop, since the 100 bushel crop will also need to be grown at a population high enough to provide soil cover, so that the sun "sees only green" in either instance. When a crop is planted at reasonable density in a field, the additional growth of a fertilized crop does not add appreciably either to interception of radiant heat or to extraction of heat from the air as discussed above. Thus, the water use of a fertilized and unfertilized field should be about the same under the same climatic conditions, even though yields may be vastly different.

Some irrigation technicians have believed that when irrigation water is applied frequently, more water is lost by evapotranspiration than with less frequent irrigation principally because of an increase in intercepted water that is evaporated. Intercepted irrigation water, rainfall, and dew are essentially as beneficial as if they entered the soil since the heat required for their evaporation does not produce transpiration that would otherwise occur. The main evapotranspiration loss from frequent irrigations is in widely spaced crops of low population plantings where the soil receives a substantial part of the incident radiation, and where evaporation from the soil will depend upon the total time it is wet. Even here, some of the heat from a dry soil is transferred to the crop and increases the evapotranspiration.

When we search for factors that affect the water loss from an evaporating surface, we should look for those factors which affect the latent heat exchange at the surface. This is evapotranspiration.

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Pasture Burning and Moisture Conservation

R. J. HANKS AND KLING L. ANDERSON

It's true that burning off land cover had some advantages when it was first practiced. But with the coming of better tillage implements and commercial fertilizer, the advantages of burning rapidly disappeared in most areas. Now, the authors cite research data to show that burning pastures also has an important effect on moisture conservation. In general, the longer cover was left on the land, the more it contributed to moisture conservation.

BURNING NATIVE BLUESTEM PASTURES has been practiced many years in the Flint Hills region of eastern Kansas. Considerable attention has been given to the influence of burning on yield of vegetation, weed and brush control, quality of vegetation, composition, succession of vegetation, etc.

There has, however, been relatively little done concerning the long-time effects of pasture burning on moisture conservation. It was the purpose of this work to study those effects.

Burgy and Scott (2) and Scott (4) studied the influence of burning on infiltration. Their results show no influence of burning on infiltration either immediately after burning or a year later.

Plots were established in 1927 by Aldous (1) with five different burning treatments. The plots have been maintained till the present time and were the site of these studies. The treatments consist of:

a. check (unburned)
b. late-spring-burned (about April 30)
c. mid-spring-burned (about April 10)
d. early-spring-burned (about March 20)
e. late-fall-burned (about December 1).

The plots were not grazed. Top growth was cut and removed each year at the time of the late-spring burning.

Forage yields shown in table 1 indicate a definite decrease in yields due to burning. Aldous (1) found a close relationship between soil moisture and forage yields. He attributed difference in yields mainly to differences in soil moisture content but pointed out that changes in plant population were also involved.

TABLE 1. Influence of time of burning native pasture on forage yields reported in pounds of air-dry forage per acre. Yields taken in early fall.

	Check	Late-spring	Mid-spring	Early-spring	Late-fall
Long-time average..	2502	2161	1934	1845	1926
1953-1956	2128	1774	1433	1361	1260

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Moisture samples taken in 1955-57 show clearly that burning influenced moisture conservation. In the spring of 1955 the check plot had 6.5 inches of available water in the surface five feet of soil compared with 1.05 inches for the late-fall-burned plot. The other treatments ranged in between. In the spring of 1956, 2.3 inches more water were available for plant growth on the check than on the late-fall-burned plots. Again in the spring of 1957 the difference was 3.47 inches in favor of the check plot.

Opportunity for Proof

Burning influences the intake of water by the soil and evaporation of water from the soil. A unique opportunity was provided in the fall of 1955 to obtain proof of this. Between September 30 and October 14, 4.47 inches of rain occurred, of which 3.75 inches came in an intense storm on October 4.

Soil moisture samples taken October 14 showed the following percentages of the 4.47 inches of moisture stored in the soil:

unburned	83 percent
late-spring-burn	46 percent
mid-spring-burn	39 percent
early-spring-burn	37 percent
late-fall-burn	39 percent

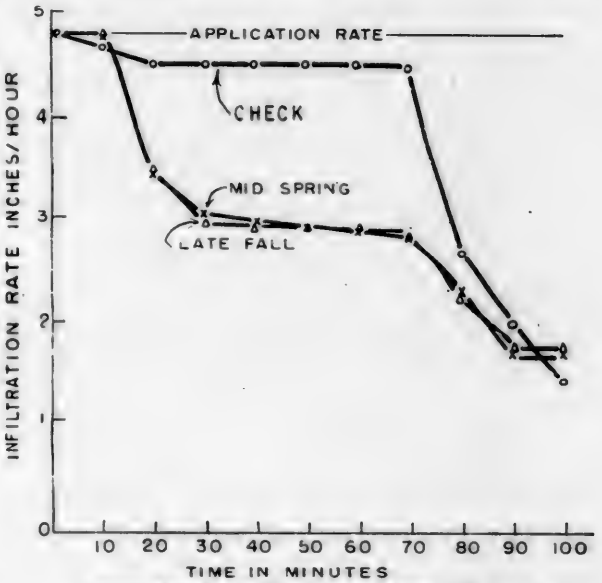
Thus about 2.5 inches of rain must have been lost as runoff on the burned plots compared with 0.7 inch runoff on the check plots. At the time of this rain all of the plots were almost completely covered with a year's growth of grass. These data indicate that burning at any time greatly decreases water intake.

Moisture Samples

Differences in intake due to time of burning were not marked; only the late-spring-burned treatment differed from the others. Moisture samples taken at the end of the growing season showed the soil to be dry on all treatments

indicating that moisture differences noted in the spring are not cumulated over several years.

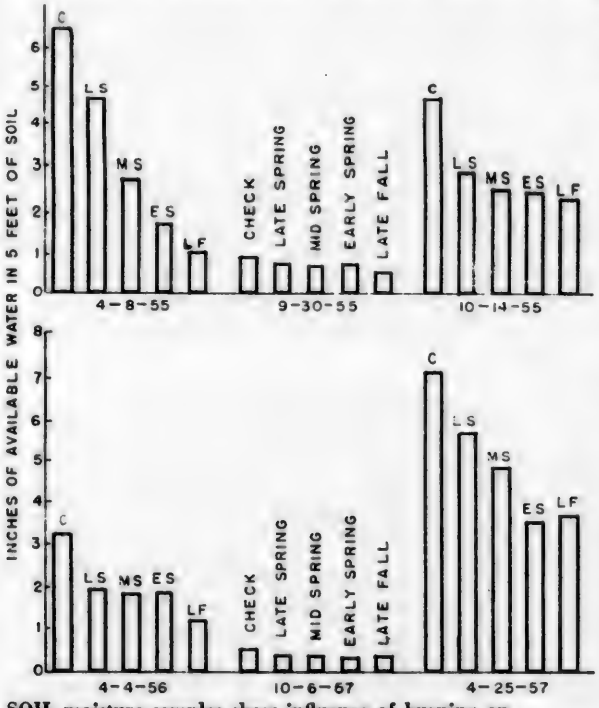
Infiltration tests conducted in August, 1955, with a device similar to that of Diebold (2) to apply water artificially to the soil showed essentially the same results. Water was added at the rate of 4.75 inches per hour for 100 minutes. The infiltration rate on the check plot was about 4.5 inches per hour for the first 70 minutes and fell off to about 1.4 inches per hour at 100 minutes. The infiltration rates on the late-fall-burned and mid-spring-burned plots were almost identical and were less than 3 inches per hour at 30 minutes, 2.75 inches per hour at 70 minutes, and 1.7 inches per hour at 100 minutes. These results, together with the results of the soil sampling data discussed above, suggest that destroying the surface mulch by burning, regardless of when it is done, substantially decreases water intake.



THE BURNING OF PASTURES influences water infiltration rate. Note the slower infiltration on land where pasture cover was burned off.

Other Factors Involved

The soil sampling data in the spring of the three years show a gradation of moisture from the check down to the late-fall-burned plot. This is evidence that some factor important in moisture conservation other than infiltration is also influenced by burning. Apparently, this factor is evaporation of water from the soil. More and more water is lost as the time from burning to the initiation of growth in the spring is increased. The grass cover from the previous year's growth is effective in decreasing evaporation from the soil. This influence has been noted many times by other investigators.



SOIL moisture samples show influence of burning on moisture storage. The earlier the burning, the less water stored.

Water conserved by burning late in the spring or not burning at all reflects itself in both yield (Table 1) and in greater water use efficiency (pounds of forage produced per inch of water transpired or evaporated). Changes in water use efficiency are shown in Table 2.

TABLE 2. Influence of burning practice on water use efficiency in terms of pounds of forage produced per inch of water used.

Year	Check	Late-spring	Mid-spring	Early-spring	Late-fall
1955	108	89	59	63	59
1956	121	116	80	72	75
Average	114	103	70	68	67
Av. Percent Increase Over Late Fall ...	70	54	5	1	—

These data show a much more efficient use of water during the growing season on the check and late-spring burned plots than on the plots burned earlier in the year. There appears to be very little difference in efficiency of the mid-spring, early-spring, and late-fall burned plots.

From the standpoint of water conservation and forage yield, it seems wise to eliminate burning as a pasture management practice in the Flint Hills region of Kansas. Where burning is advisable for some reason, it should be delayed until late spring.

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It's no wonder, then, that you get operating performance features in International crawler-dozer packages, for example, that can't be expected of other similar watershed equipment!

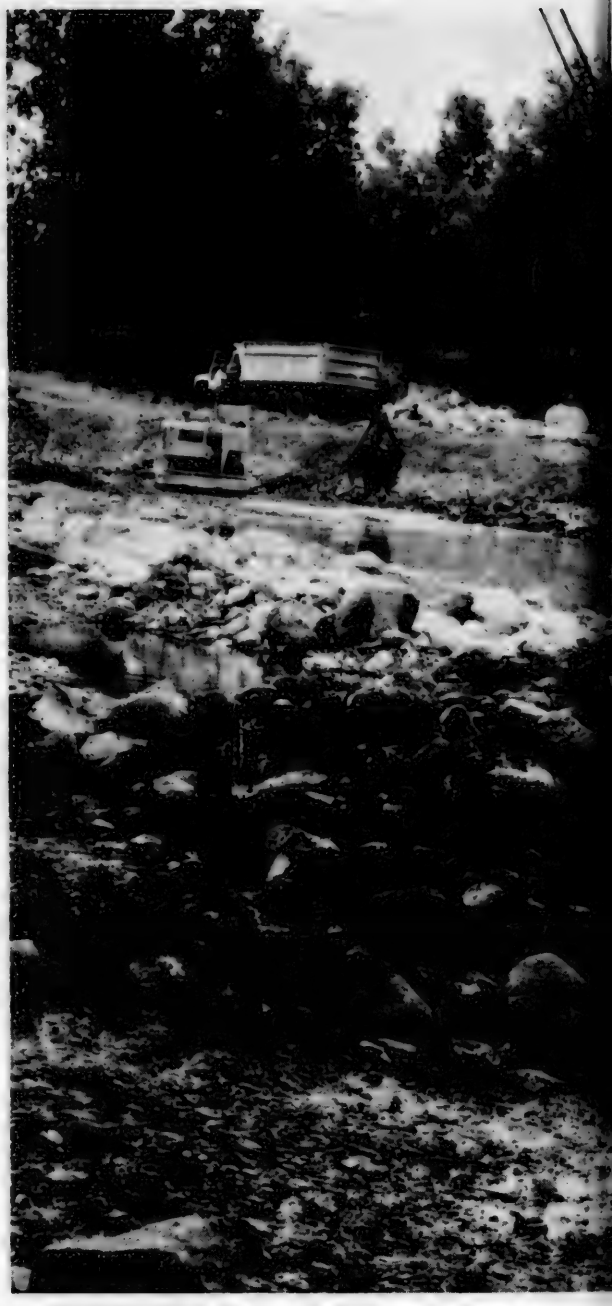
Of all giant-sized tractors, the International TD-24 is the world's only one with famous Planet Power steering. That means full-time "live" profit power on both tracks—to handle huge loads on turns as well as straightaways; upgrade as well as down! And only the TD-24 gives instant, stall-preventing Hi-Lo shifting on the go, and without using the clutch. These and other contractor-proved TD-24 features can give you immense advantages on watershed work.

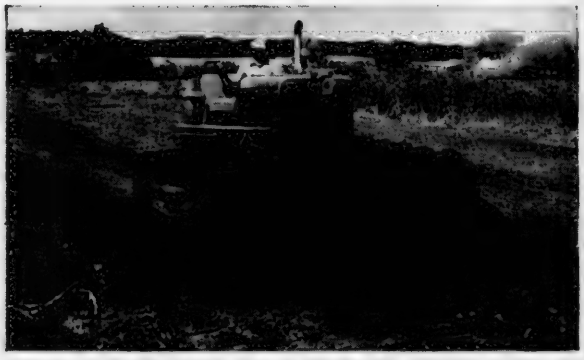
The entire job-matching Bonus-Powered International crawler line, (51 to 200 net diesel hp) and teamed blades offer a choice of outfits to fit every size of watershed jobs. And for material-moving versatility, try an International Drott 4-In-1 —exclusive four-machine utility for one moderate investment!

Prove the extra value and extra capacity of International watershed equipment. See how the wide choice and types of equipment will back your success on all kinds of watershed projects. Visit your International Construction Equipment Distributor or International Harvester dealer—and ask for a demonstration of the equipment you need.

INTERNATIONAL HARVESTER

International Harvester Products *pay for themselves in use*—Farm Tractors and Equipment ... Twine ... Commercial Wheel Tractors ... Motor Trucks ... Construction Equipment—General Office, Chicago 1, Illinois.





Building a 4,500-foot flood-control waterway on his own farm, conservation contractor Pete Trager, Olathe, Kansas, takes advantage of TD-18 cost-cutting capacity. "The TD-18 makes other similar-sized tractors look sick on clearing work," states Mr. Trager!

On a river bank flood control project near Elma, N. Y., this TD-24 'dozing boulders, mud, and debris—widening the channel. Stall-preventing Hi-Lo shifting and Planet Power steering help maintain big production in extremely adverse conditions!

"Within 30 minutes, an operator can get the feel of the TD-14 and handle the hydraulic dozer," reports Conservation Contractor Richard New, Leavenworth, Kansas. The photo shows one of his TD-14's completing a large flood-control and storage dam on contract.

Contractor Bill Lundin, Cromwell, Minnesota, does various land-clearing and water-control jobs with International equipment. Here, his blade-equipped TD-14 is clearing trees and brush for a drainage channel through a muskeg swamp.

Lands and Water and Government

ERVIN L. PETERSON

"In the Soil Conservation Society of America is brought together much of the conservation leadership of our Nation. Organized effort to achieve a wise and intelligent use of our land resources is relatively new. You are in a sense pioneers. And the opportunity before you is great."—Assistant Secretary E. L. Peterson

OUR NATION is big, rich, and greatly endowed with natural resources of all kinds. Its land area is large. In our earlier history, there was land for all who wanted it. We have been able to provide an abundance of all the materials, including food and fiber, necessary to achieve one of the highest standards of living the world has ever known. Even now, a pressing problem in agriculture is to learn to live successfully with abundance.

Yet, there are warning signs to tell us that if we would have our abundance endure, we must take steps to preserve the great productive capacity of our soils. Around us we find evidence of man's abuse of this heritage. Great forests were cut and used without provision for their regeneration. Vast land areas have been put to the production of crops, to be followed by dust bowls, floods, stream siltation, shortage of water, and their attendant harmful effects. Our fish and wildlife resources are but a fraction of what they once were. Great river systems have had their waters made unusable by pollution.

Much of our grazing lands have been badly abused and will require great effort for restoration to a fully productive state. Much of our cropland has been so used that its inherent productive capacity is materially lessened.

It is in recognition of these developments that there is growing public interest in conservation, of caring for our lands, of using them wisely. This growing public concern about conservation is representative of many interests. Not all of them have the same idea about conservation. Not all of them want the same results from conservation.

Fundamental to an organized effort to achieve the use of our lands within their capabilities is recognition that the bulk of our lands are in private ownership. They will remain so. No conservation will take place on these lands except as the owners and operators understand what conservation is, how it is to be achieved, and unless the conservation use of their lands is economically feasible.

Our public land managing agencies are sharply aware of the need to preserve and improve the productive capacity of our public lands. They know that an increase in productive capacity requires intensified conservation efforts.

At the same time, the source of funds for conservation purposes on both private and public lands is not unlimited. Our citizens are already heavily burdened with taxes. They will not willingly pay greater taxes, nor should they. If our private enterprise economy is to grow and flourish and if our standard of living is to continuously improve, new investment must keep pace with advancing technology. The need for investment capital to keep up with this rapidly advancing technology continues to grow. Unless the rewards that come from private enterprise, human ingenuity, individual creativeness and individual effort can be retained for reinvestment, our whole economy must necessarily slow down. Even now,

OUR NATION has had a history of agricultural abundance. Conservation today and tomorrow is the key to maintaining such plenty.

Ervin L. Peterson is Assistant Secretary of Agriculture in Washington, D. C. This address was presented at the Twelfth Annual Meeting of the Soil Conservation Society of America, Pacific Grove, California, August 30, 1957.

LAND AND WATER management cannot be separated. Both are important to the nation. Fortunately, *Society* members are taking the lead in conserving these resources for future generations.

our total tax-load approximates something better than one-fourth of our gross national product. This means that all of us collectively determine how each of us individually will spend better than one-fourth of our income.

In the light of these circumstances, it is particularly important that those funds which are expended in conservation efforts achieve their maximum productiveness and maximum usefulness. It is simply not possible to do all of the things that appear to need doing simultaneously.

Maximum Effectiveness

What then are the priorities of need? How shall public funds available for conservation be applied? Should they be scattered, somewhat equally, among all public conservation effort—or should they be concentrated where conservation effort seems most likely to attain its maximum effectiveness?

It is my considered judgment that the need for conservation is so great and the financial burdens imposed by government so heavy that as a nation we cannot afford to run any conservation cafeterias. We must place our conservation efforts on a carefully planned and individually organized basis. This is a decision which people concerned with conservation, and the entire public for that matter, must evaluate.

There is growing recognition that water is our number one resource problem. Demands for water are estimated to be double the present use in less than 25 years. We have suddenly awakened to the key significance of an adequate supply of clean water to the total complex of our society. We have entered the stage of competition, not only for the use of water, but for the right to use it. We see interstate compacts, the purpose of which is to divide up available water supplies among the compacting states. We see industry carefully evaluating location in relation to available water. We see great cities, and small ones too, beset with problems incident to providing water for growing populations. We see agriculture recognizing the need for controlled application of water through irrigation to assure production and to lower unit costs. We have reached the point in our development as a nation where a paramount question is this: "Who is to have water and how much?"

Water management and land management are inseparable. The term, "conservation" must include both.

Water first falls on the land as rain or snow. It either penetrates the soil and percolates into underground reservoirs or runs off to find its way again to the sea from whence it came. The condition of the surface upon which it falls determines whether or not we are able to retain and make maximum use of the water that falls. Or whether this water is lost to use, sometimes with accompanying destruction to land and other property.

Competition for Water

The forces of economic competition are at work on water supplies. How much water is needed by industry to provide goods, materials, and services wanted by our people? How much water is needed by our cities and towns to fully satisfy their inhabitants? How much water is required by our farmers and ranchers to supply the foods and fibers for our growing population? How much will these needs be expanded by the rapid growth in our population which may reach 225 million people in less than 25 years? How will these limited supplies of

CONSERVATION means different things — even to farmers and ranchers. Among other groups, differences widen still further.

water be divided up between industrial, domestic, and agricultural uses?

Who will make the allotments? On what basis will they be made? What can be done to meet the increasing demands for water? Who is responsible for doing it? How will the cost of water developments be shared among the immediate users and government? Which government—federal, state, or local? What is the role of private enterprise in these problems?

These are questions before us now. How we answer them may shape the course of our future as a nation. The kind of answers we use is everyone's concern. While we have considerable experience to assist us in charting our future course, our efforts thus far are neither well-understood, nor well-correlated. Nor have they achieved maximum effectiveness. Because the problems are so pressing, disposition of public funds available for resource conservation needs careful scrutiny.

This organization and its membership represents in large measure national conservation leadership. Other organizations similarly devoted to conservation are likewise giving attention to conservation problems.

Would it be desirable for there to be an interchange of views between the many conservation organizations as to how and in what areas of effort public expenditures should be made to advance the conservation use of our land resources? Can each area of interest afford to continue independently of what is being done elsewhere and thus, in a measure, dissipate its efforts?

I suggest counselling with other conservation minded organizations for the purpose of exerting an influence upon the disposition of public resources available for conservation activities, and the recommendation of allocation of those resources where they can be most effectively employed.

Within the Department of Agriculture, there are many programs which directly or indirectly affect nearly the entire land surface of the country. Directly related to conservation, are programs of research, of education, of technical assistance, of credit, of cost-sharing, of land management. In fact, programs of the Department of Agriculture affect either directly or indirectly nearly the entire land surface of our country. The Department of Agriculture is in fact a principal conservation agency of the federal government. It has many and varied cooperative relationships with state and local governmental agencies and thus its program effects are widely disseminated.

Other agencies of the federal government have important responsibilities in water and resource development also. The Department of the Interior, through the Bureau of Reclamation, the Bureau of Land Management, the Fish and Wildlife Service, and Park Service, has many programs concerned with resource development and use.

The Department of the Army, Corps of Engineers, with a long and distinguished record of accomplishment in the water management field, has a continuing program dealing largely with flood control which is affected by programs of both Interior and Agriculture.

Nearly all of the states have agencies of state government operating in the resource field. Forestry departments, Conservation departments, Conservation boards and commissions, Fish and Game departments, State Engineers, Highway departments, Departments of Agriculture, all having some impact upon resources, their development and use.

Local Governments

Various forms of local government likewise have a direct impact upon resource development and use—water conservancy districts, Soil Conservation Districts, irrigation districts. Assessment policy upon land by local government has material impact upon the conservation use of land and its resources.

Cities have water departments, sanitary facilities, department of parks, zoning ordinances, and many other means by which they affect both the economic, health, recreational and esthetic values associated with conservation. Private enterprise is greatly interested in all these fields. There is, in fact, a tremendous amount of effort, both public and private, increasingly devoted to the problems of conservation.

How can all this effort best achieve common purpose? How can we best develop a nationwide water and natural resources policy within the framework of which private initiative risk capital can work in harmony with local, state and federal governments? What should such a policy encompass?

Certainly it should attempt to provide a means whereby all efforts to achieve better use of our resources are complementary each to the other. Such a policy should,

I believe, clearly define the role of government—local, state, and federal—and of private initiative.

It should recognize that the role of government, particularly the federal government, is cooperative, neither preemptive nor dominant. It should place maximum possible responsibility in states and local communities and with the people who manage our land resources. Action by government should influence rather than dictate, for we must continually recognize that conservation—the wise and intelligent use of our lands—will be achieved only as people understand what conservation is, how it is achieved, and as it is economically feasible.

The protection of our thousands of small watersheds, for example, involves engineering, agronomy, soil science, forestry, and the practical problems of farming all in an interrelated manner.

Economic Limits

The conservation management of land requires recognition that there are economic problems and economic limits to achieving the optimum use.

Where, then, does individual responsibility end and public responsibility begin? This question is particularly pertinent with respect to public programs which share with landowners and operators the cost of performing conservation practices on their own lands. The same kind of a question is applicable with respect to the beneficiaries of public works for mitigation or prevention of flood damage. If a revetment works through a city prevents the flooding of property and thereby makes that property more valuable, should not the owners make some payment toward the cost of the protection?

There are, of course, more questions applicable to the complexity of problems associated with soil and water conservation than there are answers. Each of the several programs now operative has its individual purposes and history. Each has its ardent supporters. The report of the Presidential Advisory Committee on Water Resources Policy makes this abundantly clear. That report is having a salutary effect upon the several Federal agencies, and already improved correlation and cooperation is beginning to be evident.

There is much yet to accomplish. Real progress will come only from informed and expressive public opinion. Conservation leadership everywhere has a responsibility to stimulate and encourage public discussion and expression regarding conservation programs and conservation policy.

Yet conservation is not the same thing to the farmer, the forester, the cattleman, the head of a metropolitan water department, the industrial manager, or the city dweller seeking temporary escape from complexities of urban living. To those who love the out-of-doors—wilderness enthhusiasts, fishermen, hunters, naturalists, campers, picnickers, hikers—conservation has still different values. All these interests are far from identical. But all place pressure upon our land resources and the products, including water, which come from the land.

What then is conservation? Which use or user shall have preference? What order of priority shall be ascribed to the several possible uses of our land resources?

For my part, I regard conservation as intelligent use of our resources to provide for the needs of people in a growing economy, while at the same time preserving and improving the capacity of these resources to produce materials and services for continuing use. Natural resources can have no significance except as they are related to the needs of people.

Fertile fields, great forests, the latent power of our great rivers, are of concern to us only as we can use them to satisfy our physical, recreational, and esthetic requirements. These natural resources require management to prevent needless dissipation. They must be used wisely so that they may be renewed after each use. Conservation means use without abuse—use of the product without eating up the capital. This kind of use requires knowledge and understanding of the physical and economic and social forces at work on each resource value.

One of the necessary elements in achieving a constructive resource policy is recognition that no single resource use be considered independently of all others. All uses

WATER supplies establish an absolute limit beyond which we do not go. Question: Who allocates supply among competing needs?

are in some measure interrelated just as land and water conservation are interrelated.

At a given time and place one type of use may be the dominant one. However, resource policy should not permit recognition of one use or type of use, or one interest or type of interest to the exclusion of all others.

Multiple use is a familiar concept in national forest management. Farm, grazing and private forest lands are subject to multiple use also. Much if not most of them are now so used.

As private owners and operators find increasingly the benefits of conservation management, and as research and education further contribute to such management, multiple use may be further extended. We recognize, of course, the elemental needs of people for water, for food, clothing, and shelter. We recognize the need of our industrial community for materials for manufacture into goods which help provide employment and an improving standard of living. These needs are not incompatible with conservation. In fact, strong support for conservation comes from the business and industrial community.

Essential to sound resource policy and to conservation management of our lands is an organized approach to its achievement. Equally essential is an objective measurement of the physical task which lies ahead.

The U.S.D.A. "conservation needs inventory" just now getting underway is aimed toward that measurement. It is the first such inventory of the national physical conservation needs ever undertaken.

The Great Plains Program (as contained in Public Law 1021) should demonstrate the value of a planned, coordinated conservation effort over a wide area on farm and ranch units.

The Small Watershed Program (Public Law 566, 83rd Congress) and its predecessor programs demonstrate dramatically the value of simultaneous land and water management. This program also demonstrates most graphically the fact that land management and water management are inseparable. In the recent Southwest floods, the small watersheds which have been completed performed well.

DEMAND for water to be used for recreation is growing. This non-consumptive use need not conflict greatly with many other uses.

This is a program which we believe has great validity. We intend to press forward with it as vigorously as resources available to this program permit. Here again public determination of how monetary resources available for conservation programs should be distributed becomes of real importance.

Now finally, as we seek better conservation programs, as we seek sound policy for nationwide application and use, as we seek better application of the resources available for conservation effort, let us remember that ours is a government of sovereign states—a representative government—where the power of decision rests with people themselves. This kind of government requires informed people willing to act according to their convictions.

What are their convictions as to government responsibility in the area we are discussing? What are our own convictions as individual citizens?

"Big" Government

Let us remember that government is already big. Its actions affect in increasing degree the lives of each of us. It has propensity for growth. A major question of our time is this: "Shall man be master of his government and thereby of himself, or shall he, by his silence, allow himself to become so dependent upon government that he is master neither of it nor of himself?"

To the extent citizens as individuals deny their individual responsibilities of citizenship, so they make more difficult the functioning of representative government. Freedom as we know it is indivisible—all must have it or *none* can have it.

If as individuals we increasingly turn to government for a solution to our problems, we must surrender correspondingly our right to make decisions for ourselves. This is the road to bigger government.

Ours is a complex society. Ours is a big nation. Big organizations wielding great power, both economic and political, are commonplace. Big problems appear and reappear. In this kind of a situation we can either become a nation of big individuals measuring up to the needs of our time, or by our own indifference turn to government for answers to more and more problems which we are capable of solving for ourselves. We can—even unwittingly—substitute big government for big problems and find no solution.

The proper function of government is to unleash the creative capacity of its citizens. Working cooperatively, it is within our capacity to achieve perpetual use of our natural blessings of soil and water. It is within our capacity to achieve a nationwide natural resource policy within which there is a creative place for everyone—conservation is everyone's business.

WEATHER MODIFICATION: Problems and Possibilities of Increasing Water Supplies

HOWARD T. ORVILLE

Drought and water shortages of recent years have multiplied the interest in the possibilities of weather modification. Some of this interest stems from faint hope that rain can be produced at will to save parched crops or to replenish failing water supplies. Fortunately, a more enlightened interest also centers on the problem. It is this scientific interest that promises to evaluate weather modification objectively and determine its usefulness to mankind.

OUR WATER PROBLEM is growing. Shortages constantly plague one area or another in the United States.

For seven years, until this spring, drouth in the Midwest and Plains States caused untold suffering and billions of dollars of property loss. This year the worst drouth in history struck the Atlantic States from Maine to the Carolinas. Some of the semi-arid Western States are always faced with water shortages to a greater or lesser degree.

Unless we take steps to alleviate the growing shortages, the present explosive increase in population will cause water shortages 10 to 20 years from now that will make present drouth conditions seem almost insignificant in comparison.

It behooves those of us who are interested in water problems to investigate every possible approach in basic and applied research that may help preserve and augment our present water supplies. We should make every possible effort to meet the growing demands in the future. Water storage—both underground and surface, our system of multiple dams, development of methods to prevent evaporation from water surfaces on reservoirs and lakes, and finally, weather modification are a few of the possible methods of increasing our water supplies.

Weather Modification

This paper deals only with weather modification and the problems and possibilities of using cloud seeding methods to increase the water supplies in the United States.

As early as 1947 spectacular demonstrations of weather modification were observed in western Massachusetts and around Schenectady, New York, by two scientists of the General Electric Company—Dr. Irving Langmuir, Nobel prize winner, and his assistant Dr. Vincent Schaefer. By dropping dry ice into supercooled clouds they were able to cause snow to fall from the cloud. Later that year another associate, Dr. Bernard Vonnegut, found that silver iodide injected into a cloud will cause essentially the same effects as dry ice.

For 10 years now there have been varying claims, some completely fantastic, of so called rain-making by using the methods developed by Langmuir and Schaefer. Many of these alleged claims proved to be unfounded. And many farmers vitally interested in getting water were greatly disappointed. In fact, so disappointed that they wrote their representatives in Congress to look into the problem.

Advisory Committee on Weather Control

Congressmen became interested and introduced several bills. After extensive hearings a bill originated by Senator Francis Case of South Dakota was passed in 1953 that became Public Law 256. This law established an 11-man group known as the Advisory Committee on Weather Control. The committee held its first meeting on December 18, 1953. Since that date it has been conducting an exhaustive evaluation, with the assistance of a highly competent technical staff, to determine what results, if any, were being realized from operations by commercial cloud seeding companies in the United States.

The Evaluation Program

After collecting numerous reports from domestic and foreign sources and consulting with many scientists, an evaluation program, directed along two principal fronts, was established by the committee. One method of evaluation consisted of a program in which the validity of present cloud seeding techniques were put to close scrutiny. The other method of evaluation was one in which the rainfall data in areas being seeded were subjected to a careful statistical analysis to determine whether cloud seeding had decreased rainfall, increased it, or had no effect at all.

In a letter report to President Eisenhower on June 28, 1957, the committee summarized the results of the evaluation programs as outlined below:

Howard T. Orville is Consultant, Friez Instrument Division, Bendix Aviation Corporation in Baltimore, Maryland. He is also chairman of the President's Advisory Committee on Weather Control.

I. Physical Evaluation Program

OPERATION OVERSEED: A small scale seeding experiment, designed to simulate the conditions under which commercial cloud seeding operations are conducted in mountainous country, was carried out in the vicinity of Mt. Washington, New Hampshire, from September 1955 to June 1956. The target was the observatory at the summit, which is equipped to make measurements of the number of ice nuclei, liquid water content, and drop size as well as the routine meteorological observations. The principal results can be summarized as follows:

1. Ground-based silver iodide smoke generators can increase the concentration of ice nuclei in the lower atmosphere at distances up to 12 miles by a significant amount.

2. Present techniques appear to place the upper limit of nuclei concentrations so produced at this distance between 10^4 to 10^5 particles per cubic meter (measured at –20 degrees Centigrade) under average atmospheric conditions.

3. "Overseeding", the flooding of supercooled clouds with artificial ice nuclei, does not appear to be possible with present equipment under average atmospheric conditions.

4. Silver iodide nuclei produced by the propane-acetone method have a decay rate of not more than two orders of magnitude per 30 minutes exposure time at –15 degrees centigrade, and probably less. Time-delay tests reveal no rapid decay rate in the first three minutes. This would indicate that, under these conditions, deactivation of the nuclei is not a matter of concern.

PROJECT SKYFIRE: In order to test the behavior of silver iodide smoke from ground generators during summertime conditions over comparatively flat country, a glider and a low speed airplane, carrying a portable cold box by means of which ice nuclei measurements could be made at frequent intervals, were used during the summer of 1955. Silver iodide nuclei detected to a maximum distance of 15 miles and a maximum height of 4,000 feet above the generators with concentrations of 35 to 100 per liter at these distances. This program was conducted again during the summer of 1956 as part of "Project Skyfire", a cooperative program conducted by the U. S. Forest Service to study clouds and thunderstorms and develop and test cloud seeding techniques pointed toward the suppression of lightning.

The more important results are as follows:

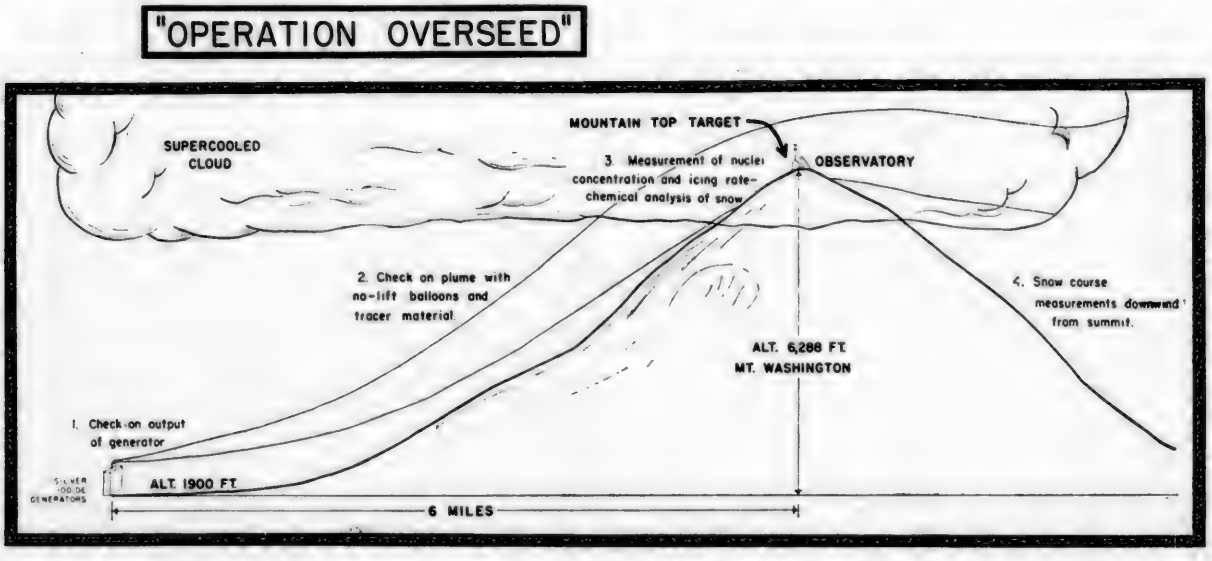
1. Using the airborne portable cold box, it was possible to track the silver iodide smoke plume from ground generators as far as 35 miles and measure concentrations at cloud bases where the nuclei were causing visible seeding effects.

2. Calculations show that virtually all the summer precipitation in the interior mountain areas of the Pacific Northwest must be due to growth from ice crystals rather than liquid phase condensation-coalescence. In view of the low natural ice nuclei concentrations usually present during this period, cloud seeding may be expected to have pronounced effects on cloud structure.

3. Studies of the decay rate of silver iodide nuclei indicate that the deactivation rate must be less than one order of magnitude per hour at 0 degrees Centigrade ambient temperature.

4. Small and medium size supercooled clouds seeded with dry ice showed definite glaciation and virga, with the virga in one case reaching the ground.

5. Ground seeding with silver iodide generators produced definite virga from clouds in the plume area. Airborne silver iodide seeding in a transverse pattern over


"OPERATION OVERSEED"
MOUNTAIN TOP TARGET
SUPERCOOLED CLOUD
3. Measurement of nuclei concentration and icing rate-chemical analysis of snow
OBSERVATORY
2. Check on plume with no-lift balloons and tracer material
4. Snow course measurements downwind from summit.
ALT. 6,288 FT. MT. WASHINGTON
1. Check on output of generator
SILVER IODIDE GENERATORS
ALT. 1900 FT.
6 MILES

a fixed area produced heavy virga and precipitation reaching the ground from fairly thin supercooled clouds on two occasions.

PROJECT SEABREEZE: A similar program was conducted at Boca Raton, Florida, for a period of four weeks in the late summer of 1956. This is an area where a line of tall cumulus clouds builds up practically every day at the inshore limit of the sea breeze. Time lapse cameras were used to record cloud behavior in the area covered by the plume from the silver iodide generators as well as the areas on both sides. Results of this project may be briefly summarized as follows:

1. Time-height graphs of cloud tops were constructed for 18 clouds from the time-lapse films. Time of occurrence of precipitation at the cloud base was also obtained from the films in 14 of the 18 cases.

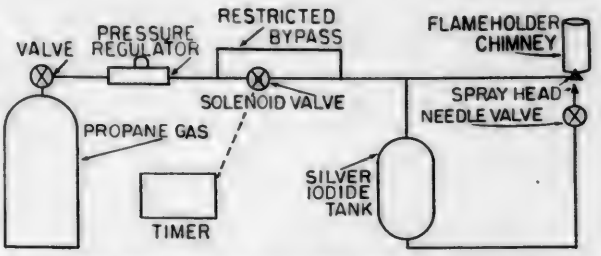
2. A precipitation-initiation model was constructed from published data on coalescence and ice crystal precipitation mechanisms. The time of precipitation initiation predicted by the model was compared with observed times from the measured clouds. In all cases the coalesence process was clearly indicated as being operative in initiating the precipitation. Under the conditions encountered in Florida this is likely to be true in most cases and the possibility of detecting a silver iodide seeding effect by observing precipitation initiation is remote.

3. Comparison of the precipitation initiation times derived from the model and the results recently published by Feteris and Mason in England indicates that coalescence operates more slowly in Florida than reported in the results for England. This indicates the possibility of smaller initial drop sizes in Florida. If this can be verified the area may be an exceptional one for tests of hygroscopic seeding during the summer months.

4. Areas of major shower development were plotted for each day with reference to the silver iodide plume direction. Principal effect appeared to be an extensive dark area usually developing about 2 p.m. to 3 p.m. Eastern Standard Time in the plume region. Outside the plume, shower areas had largely dissipated by this time. The effect was noted on seven days with generators operating and two without. More extensive aircraft observation is needed to define this effect more clearly.

5. Natural ice crystal counts in Florida were variable but generally high. In some situations the natural counts were so high that it was not possible to add substantially to the ice crystal count through the ground generator operation. In comparison with an area such as western Montana, the opportunities for demonstrating seeding effects due to silver iodide are limited.

ICE NUCLEI MEASUREMENTS: A cooperative program of ice nuclei observations was conducted during May 1957 to obtain comparative data on the various types of equipment used for such measurements. Most



SCHEMATIC DIAGRAM OF GENERATOR

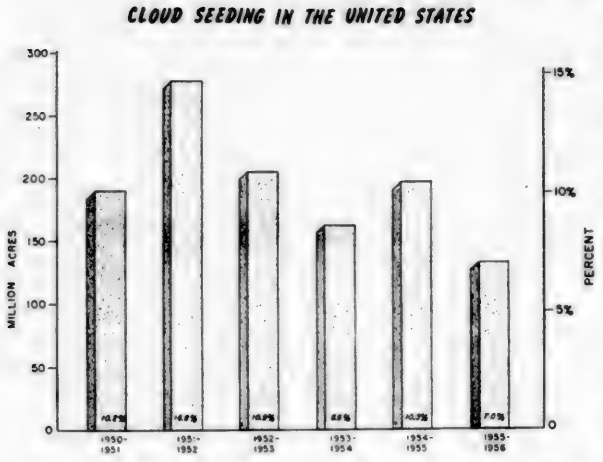
of the measurements were made on natural nuclei characteristic of the Pasadena, California, area. Samples of both silver iodide and dust from the Albuquerque, New Mexico, area were also used.

Results of the study indicated fair agreement among all the various types of cold boxes used. Principal consistent variations were the relatively lower count obtained by the Australian expansion box and the high count by the MRI cold box. Suggestive evidence was obtained to indicate that this variation was caused by the characteristics of the Australian box in measuring only fast and slow acting nuclei. On the other hand the MRI cold box occasionally gave results which were 5 to 10 times too high. This fact should be borne in mind when studying the results of projects "Sailplane" and "Seabreeze." The relative importance of fast and slow nuclei in atmospheric processes is not understood and the relative value of measuring only fast nuclei or measuring only total nuclei is not clear.

Reproducibility of the boxes on repeated samples was good and the variations between boxes were considerably less than the spread of nuclei measurements given in published literature.

SANTA BARBARA PROJECT: In order to obtain a more quantitative estimate of the increases in precipi-

LATE MODEL propane fuel generator operates unattended for more than 100 hours. Automatic timer permits pulsing of the silver iodide output.



CLOUD seeding is still in its newest stages. As one would expect, use jumps in dry years.

tation actually produced in a cloud seeding operation, a cooperative project was organized in Santa Barbara County, California, in the fall of 1956. Participating agencies are the County of Santa Barbara, the Department of Water Resources of the State of California, the statistical laboratory of the University of California, North American Weather Consultants, the U. S. Forest Service, U. S. Weather Bureau, the National Science Foundation and the Advisory Committee on Weather Control. This is to be a randomized cloud seeding operation whereby approximately half the suitable storms are seeded and the other half used as a control for comparison. In order to obtain sufficient data for comparison, the project will be carried out three years during the months of January through April. Last winter's operations, the first of the planned three years, have not yet been analyzed.

FOREIGN PROJECTS. In Australia extensive aircraft seeding has produced positive increases of 20 to 30 percent, but the results are not statistically significant due to the short time of operation in most areas. Similar reports of positive increases have been received from Japan, France and Spain where ground seeding is carried out for hydroelectric purposes.

II. Statistical Evaluation Program

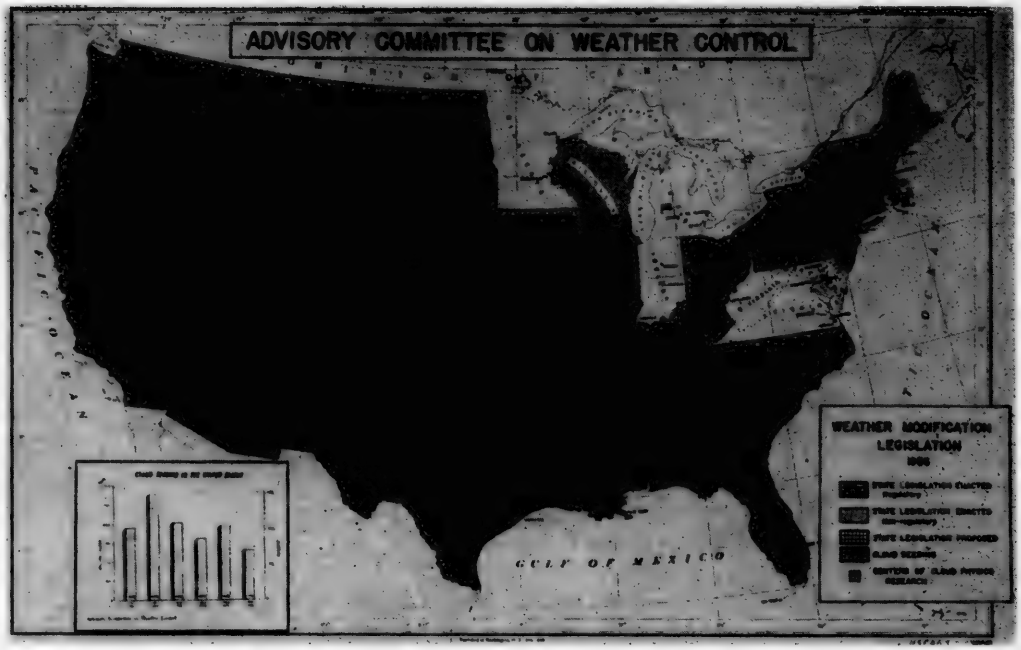
The statistical phases of the evaluation program described in Technical Reports 1 through 5, were carried out primarily by the Advisory Committee's staff, assisted during the past eight months by the statistical group at New York University. The results of the program may be summarized briefly as follows:

1. A statistical method of evaluating augmentation of precipitation by cloud seeding was developed.

2. Using this method, a series of cloud seeding operations were evaluated. The conclusion was reached that, taking the West Coast and orographic projects evaluated as a group, there has been an average increase in precipitation *during the seeded storms*. The chance that this effect is due to natural causes and not to the cloud seeding is estimated to be extremely small. The amount of this average increase in the seeded storms is estimated to lie between five and 22 percent with a confidence of 90 percent, i.e., one chance out of ten that the actual increase is above or below this range.

3. Evaluations of cloud seeding operations in the comparatively flat lands of the Midwest and East failed to show any indications of effects from cloud seeding. This does not mean that effects may not have been produced

NOTE the disturbed area in the center of this cloud photo. This area was seeded 25 minutes before photo was taken. U. S. Department of Defense photo.



THIS map shows states in which weather modification legislation of some kind has been enacted or proposed.

but that, if there were any effects, they were too small to be detected with any degree of confidence by presently known statistical methods.

4. A method for fitting the frequency of hail occurrence to certain mathematical distributions was developed and used in establishing a procedure whereby operations designed to reduce hail might be evaluated.

Preliminary Conclusions

The Advisory Committee has established, with a satisfactory degree of probability, that cloud seeding operations on the windward slopes of the Pacific Coast States during the cool and moist winter and spring months have produced significant over-all average increases in precipitation from the storms seeded over that which would have been expected without cloud seeding. At this time the committee's studies do not enable it to apply these conclusions either to the results of cloud seeding in other portions of the nation or to the possibilities of hail and lightning suppression.

In connection with the results observed in the West Coast mountainous areas, it is interesting to note a portion of the new policy statement of the American Meteorological Society relating to cloud seeding in mountainous areas: *"Evaluations performed by independent agencies have yielded reasonably convincing evidence of increases of precipitation due to the operation of ground-based silver iodide generators only for operations conducted in cold weather in regions where forced lifting of the air over a mountain range is an important factor."*

It is essential that additional research be conducted to ascertain whether, under favorable circumstances, the positive results of cloud seeding in the mountainous terrain of the Pacific Coast states can be extrapolated to the mountainous areas which exist elsewhere in the United States. It is equally important that a long range program of basic and applied research in the precipitation processes as they occur in other areas be initiated as soon as possible. Increased knowledge of the potentialities of weather modification gained through such research may become of great importance to the production of additional water supplies for agriculture, hydro-electric power, and municipal and industrial uses, and thereby make a substantial contribution to the solution of the Nation's water resources problem.

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   B. Report No. 2—*"An Evaluation of a Series of Orographic Cloud Seeding Operations."*
   C. Report No. 3—*"The Frequency of Hail Occurrence."*
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Wildlife Areas in Relation to Land Utilization

A. W. BROMLEY

More and more of the people of our country are looking to hunting and fishing for their recreation. In fact, fishing is the all-American participant sport. While hunting and fishing are on the increase, areas suited to these sports become fewer and smaller. The increasing recreational pressure demands that wildlife areas receive more consideration in land utilization planning of the future.

A. W. Bromley

WILDLIFE RESOURCES have played a vital role in the settlement and development of this country. Game that fell to the pioneer rifles was important in maintaining a foothold in the wilderness. Buffalo, antelope, and deer should be credited equally with the covered wagon in making possible the settlement of the West.

But 300 years have wrought unbelievable changes. Demands upon and exploitation of our natural resources have altered the face of our land. Our pattern of life, once almost primitive in its simplicity, has evolved through pioneer to rural to urban cultures, picking up speed and complexity enroute.

Population Trends

Today our country has some 165 million people. The Census Bureau estimates, conservatively, that in another 20 years our population will exceed 210 million, requiring 50 to 60 per cent more resource use. Yet at the present time, about 1.7 billion of the nation's 1.9 billion acres of surface area are used for farming, forestry, or livestock production—with limited opportunity for further expansion. In fact, a reverse trend toward withdrawal of lands in production of food and fiber is gaining momentum.

The swelling population of cities is rapidly spreading to adjacent rural lands for living room, and industry is following the march to the suburbs. At the present rate of expansion, urban and industrial development which today occupies 25 million acres will, by 1975, utilize 35 million acres. A vast highway system has absorbed millions of acres of one-time rural lands and further expansion is inevitable. The demand for potable water and water for irrigation and hydro-electric purposes, presently responsible for withdrawal of millions of acres of land for reservoir use, is increasing rapidly. At the same time, extensive areas have and are being drained for crop production.

The Soil Conservation Service has estimated the original natural wetlands of this country at 127 million acres —of which some 45 million acres have been drained. These figures conform closely to findings of the recently completed wetlands survey by the U. S. Fish and Wildlife Service.

Where do our wildlife resources stand in this rapidly moving play of forces? Through lack of coordination in natural resource policy, preservation of wildlife habitat has received scant attention—and even less consideration.

The public, meanwhile, is exerting ever increasing

SOIL AND WOODLOT conservation practices can do a lot to enhance the value of many acres—for both man and wildlife. New York State Conservation Department photos.

A. W. Bromley, of the New York State Conservation Department, presented this paper at the Eleventh Annual Meeting of the Soil Conservation Society of America, Tulsa, Oklahoma.

pressure upon the remaining wildlife lands. Hunting and fishing is by far the most popular participant sport in the Nation.

This, of course, is a generally recognized fact. Only recently, however, has information been available to appreciate fully the tremendous impact of hunting and fishing as recreation upon our national economy. To lift a capsule synopsis from the recently published findings of the Crosley Surveys: "Twenty-five million fishermen and hunters spent three billion dollars for 500 million days of sport, and drove their automobiles 10.4 billion miles in pursuit of this recreation during 1955."

Recreation Use Increases

Moreover, adoption of hunting and fishing as a recreation is climbing today at a rate far in excess of population growth—due largely to the shift to urban living, ease of rapid transportation, greatly increased leisure time and Man's growing need to escape, periodically, the frenzied demands of modern-day life.

Confronted with increased withdrawal of wildlife habitat for agricultural, industrial and urban development, conservationists and fish and game administrators have been hard pressed to meet the steadily mounting public demand for hunting and fishing opportunity. So far it has been a losing battle. Wildlife is something of an orphan child in the natural resource family. Its place at the table has long been usurped by higher priority brothers offering greater prospects of immediate economic gain—despite evidence that such gains may often be short term or destructive in nature.

Recognition for Wildlife

There are encouraging signs, though, that the nation is coming to recognize wildlife as a rightful member of the natural resource family. It was accorded a prominent place on the agenda of the 1953 Mid-century Conference on Resources for the Future where leaders in the fields of education, science, agriculture and industry recognized our wildlife resources as a vital element in shaping a balanced national resource policy.

Some means to install the "orphan" as a legitimate member of the natural resource family are now evident; others will be found through continued research and surveys. Among the steps which, on the basis of present knowledge and experience, should now be taken are:

1. Effect greater harmony in governmental resource policy. There is a "crying" need for more intelligent, better coordinated administration of our whole natural resource policy, particularly as it effects land use. Too many governmental agencies are proceeding simultaneously in too many administrative directions to accomplish often contradictory objectives. Funds from one branch of government go to subsidize wetlands drainage to produce agricultural crops already in surplus supply for purchase with other public funds. At the same time another public agency spends time and additional funds attempting to restore wetlands habitat for wildlife.

Creation of a federal department of natural resources appears to be an effective means to minimize waste and duplication in resource administration and an essential if wildlife is to survive the present land use scramble.

2. Use of available state and federal monies to acquire the maximum possible acreage of lands presently serving their most important function as wildlife habitat or capable of development for that purpose.

Submarginal Lands

Lands of submarginal value for agricultural purposes and outside the probable sphere of urban spread offer opportunities for acquisition and development for wildlife habitat. Existent wetlands, low lands difficult to drain and poorly productive one-time wet tracts mistakenly drained for crop production should be given top

MARSHES are among the most productive wildlife areas. They furnish recreation, dollar returns, natural areas as well as variety in landscape.

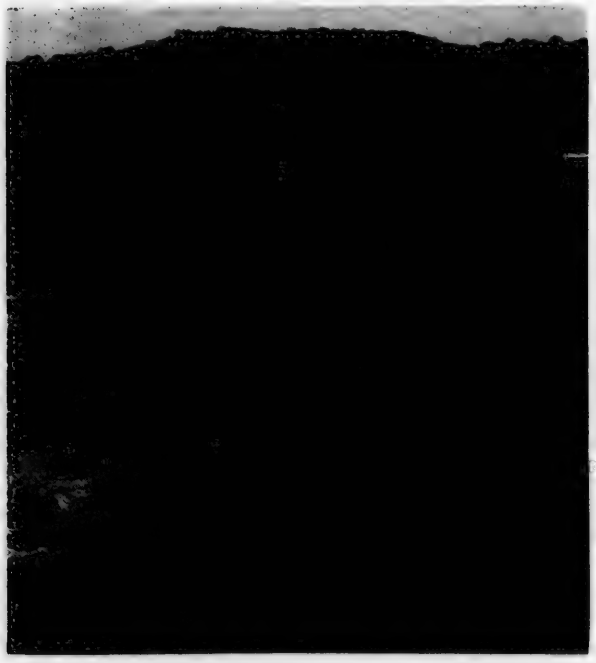
MONEY and effort spent to drain natural wetlands may accomplish only part of the purpose. Often flooding still occurs.

IN MANY areas, a small marsh or farm pond can add a great deal to the pleasures of farm living.

priority for wildlife area acquisition. Acre for acre, wetlands exceed all other land types in wildlife productivity, particularly for waterfowl and furbearers. Moreover, such lands respond more quickly and bountifully to known wildlife management techniques.

3. Greater emphasis on management of lands in public ownership for multiple use benefits including improvement of wildlife habitat. The National forests and State-owned forest lands offer opportunities for coordinated management practices that will benefit both timber production and wildlife populations. Publicly owned grazing lands also offer opportunity for improving habitat and better management for wildlife.

A STREAM of fast clear water once flowed through this valley. The entire community would benefit from a small watershed program which would reclaim this fishing stream.



4. Closer federal, state and community cooperation with farmers and others on privately owned property to cooperatively develop a comprehensive conservation program tailored to fit specific soil, water and cover requirements. The federal soil conservation program, state agricultural extension services, cooperative wildlife habitat improvement programs and federal-state-community-property owner watershed conservation projects are good examples of constructive conservation at the grass roots.

Wildlife Resource

The bulk of our wildlife resource today and in the foreseeable future will be produced on privately owned rural lands. Wildlife conservationists can have no greater goal than development of this resource potential to its maximum compatible with landowner tolerance and sound land use.

5. More education of the public is needed. It is encouraging to find that leaders in the cultural and scientific fields are increasingly aware of the importance of our wildlife resources. Conservationists are rightfully heartened by this much gain. But progress thus far should be seen only as an entering wedge—a preliminary to an educational campaign employing every possible media to reach the people. The farmer, the mechanic, the executive, the housewife, the schoolchild—all the people must be made to understand why our wildlife resources are important to them. Only thus can we achieve intelligent legislation and proper administration to accord wildlife its rightful place in our natural resource family.

Book Reviews

WATER FOR AMERICA: The Story of Water Conservation. By Edward Graham and Wm. R. Van Dersal. *Oxford University Press, 114 Fifth Avenue, New York 11, New York. 112 pages, illustrated. 1956. $3.50.*

Many fine books on water have been written in recent years. None, however, have hit on the unusual presentation featured in this excellent publication. Each subject is contained on a single page with a well-chosen photograph on the left page. Fifty-three aspects of water are concisely explained in this manner. Some of the page titles are "Water Around Us," "Water in the Ground," "The Big Rivers," "New Uses for Water," "Water for Crops," "Soil and Water Conservation," "Water Forecasting," "Upstream Controls," "Water Shortages," "Treating Watersheds," "Study" and others.

Water for America is written in a clear readable style. It presents the origin and source of water, its uses, the interdependence of all water users and the methods that are being used to conserve and further develop this basic resource. Each topical discussion presents an over-view which is followed with statements concerning what is now being done and some new approaches that may be needed. The section entitled "Study" is exceptionally well done and challenging, too. It could well be titled "What We Need To Know." Actually, the authors raise many questions for which answers must be found if the nation is to meet its future water requirements.

Both authors are members of the staff of the Soil Conservation Service, United States Department of Agriculture. They write with authority and understanding—thus giving the subject realism and direction. The book should appeal to everyone familiar with the values of water as well as those that are not. High school students will find it particularly useful in classroom discussions and as a source for reference. Consequently, this inexpensive book should be on the shelf of every school library in the nation. Conservationists, supervisors of soil conservation districts, and others concerned with water and its development will also find *Water for America* extremely helpful.

—Walter C. Gumbel, *Fairmont, West Virginia.*

SOIL CONSERVATION. By J. H. Stallings. *Prentice-Hall, Inc., 70 Fifth Avenue, New York 15, New York. 575 pages, with photographs, charts and graphs. 1957. $8.50.*

The purpose of this book as stated in the foreword by R. B. Alderfer of Rutgers University is ". . . to document the efforts and accomplishments of the soil and water conservation movement during the past two decades."

Actually, it is much more than this. The author has done a superb job in showing how the data for one subject-matter division was related to those in each of the three other divisions. Consequently, the book is not only broad in scope, but also factual in all its related aspects. This is an achievement not many authors can claim—especially with a subject of so many facets.

Soil Conservation contains four divisions: Part 1 deals with the historical phases of soil erosion, Part 2 with the fundamental problems of soil conservation, Part 3 lists and describes soil conservation practices, and Part 4 deals with the farm and watershed planning.

This reviewer was impressed by the manner in which the author presented each subject. His statements are documented by research data and a long list of references at the close of the chapters. Obviously, the book is an authoritative statement of what is generally known and what is fact concerning all phases of soil conservation. Land owners, conservationists, foresters and others having interests or responsibilities in this field will find the material extremely useful. The book could well be considered a handbook of soil conservation.

The many excellent photographs have all been well-chosen. Tables, charts and graphs are also important important parts of the book. Each gives further emphasis and clarity to the subject matter.

Dr. J. H. Stallings spent 20 years in the Soil Conservation Service where his early experiences date back to the beginning of the conservation movement in North Carolina. Following this he spent 16 years in the Washington office—eight years of which were devoted to the analysis of research work conducted throughout the nation. It was during this time that much of the material in *Soil Conservation* was assembled and carefully checked.

We Can All Help SAVE OUR SOIL. By O. R. Zeasman and J. W. Clark. *Extension Service, College of Agriculture, University of Wisconsin, Madison, Wisconsin. Circular No. 360. 40 pages illus. Revised 1956.*

This excellent circular has been endorsed by the State Superintendent of Public Instruction in Wisconsin. The soil conservation story is told simply and effectively at a level suited to the upper grades in an elementary school.

Field Notes

Tribute to a Conservationist

Marion, Ohio
May 9, 1957

Dear Mr. Williams:

We, the girls and boys of the sixth grade from North Main Street School, would like to tell you how much we enjoyed the field trip we took with you last week.

Many of us have never lived on a farm so much was new to us. We have seen many trees but we didn't know there were ways of telling how old they were. We didn't know you could make fences out of "rose bushes." They are much prettier than wire ones. We have seen many farmers plowing fields but we never thought it would make a difference which direction they plowed.

If we ever live on farms we have decided that we would like to have lakes on them. Even if we don't need them for drainage and reservoirs, they would be pretty nice for fishing and swimming.

We are pretty happy that there are men like you who are trying to teach the farmers to save the soil. When we grow up and our children grow up it is nice to know that the farmers will still be producing the necessary things for life. Gloria wants to know if there are any lady conservationists?

You were very kind to direct us on our trip, and you were pretty patient with us even when our attention strayed when you were explaining things to us.

We are writing stories and making pictures to illustrate many of the things you told us about.

Mrs. Bradley and we want to thank you again for your kindness and all the things we learned from you.

Sincerely yours,
N. Main St. Sixth Grade.

South Carolina Revises Irrigation Guide

"If I'm going to stay in the business, I've got to irrigate." That's a common comment heard throughout South Carolina from the truck, tobacco, peach, and cotton growers.

These are big money crops. An adequate supply of water during the growing season may mean the difference between profit or loss for the producers of these crops. Consequently, water supply development and irrigation have come to be prominent practices in the soil and water conservation program in South Carolina. This, in spite of the state's average annual rainfall of 47 inches.

Soil Conservation Service technicians have necessarily had to keep pace with this development. A good start was made in 1950 when South Carolina took a cue from Western states and prepared the first sprinkler irrigation guide for any state in the humid area. This guide, which was prepared specifically for the truck farming section of the lower Coastal Plain, represented the best thinking of SCS engineers, soil scientists and conservationists, as well as representatives of experiment stations.

The original sprinkler irrigation guide for South Carolina has been revised on two previous occasions. The second revision expanded the coverage of the guide to include all of the Coastal Plain and the Piedmont sections of the state. The third revision is now in progress. Research information on supplemental irrigation in the humid area was rather scarce at the time the first guide was prepared. Since that time, the demand for irrigation and supply of research information have been drawing closer and closer together. It is reasonable to expect, therefore, that as more information becomes available, further revision will be necessary.

An irrigation guide is not an operating tool. It furnishes information to the designer of an irrigation system by presenting the characteristics of different soils and requirements of different crops and gives the manner in which these characteristics are reflected in the design and operation of an irrigation system.

The irrigation guide is a most effective way of passing along to designers of irrigation systems, irrigators, and prospective irrigators the latest information available on soil, plant and water relationships. Regular review and revision of the irrigation guide also is a means of maintaining close working relationship with others who are interested in this field. In South Carolina, this is a function of the Engineering Subcommittee of the State Soil Conservation Committee.

The South Carolina irrigation guide, of course, is available to all Soil Conservation personnel. In addition, it has been widely distributed to other agricultural workers, farmers and manufacturers and dealers of irrigation equipment and supplies throughout the United States.

Whether it be truck crops, tobacco, peaches, or cotton, the grower is entitled to the best information available for the design and operation of his irrigation system. An up-to-date irrigation guide, widely distributed, is the tool used in South Carolina for meeting this important responsibility to our farmers.

—James L. Aull, *Columbia, South Carolina*

Fellows and Honorary Members 1957

J. H. Christ

Frank L. Duley

R. D. Hockensmith

Paul G. McGrew

THE SOIL CONSERVATION SOCIETY OF AMERICA *annually selects individuals who have made outstanding contributions to the science of soil and water conservation to honor as Fellows and Honorary Members.*

FELLOWS—*This honor goes to members professionally engaged in practicing, investigating, or teaching soil and water conservation.*

JOHN H. CHRIST, *Honolulu, Hawaii.* Now Territorial Conservationist for Hawaii, Soil Conservation Service, Mr. Christ is a native of Indiana. He moved to Idaho with his parents at an early age. He received his B.S. degree in agronomy from the University of Idaho in 1919 and his M.S. degree from Iowa State College in 1920.

Following his graduation, he headed the University of Idaho Sand Point Experiment Station until he joined S.C.S. in 1935. Before taking over duties in Hawaii in 1954, he served successively as Idaho State Coordinator, Pacific Northwest Regional Conservator, and Pacific Regional Director for S.C.S.

His interest in the use of native plants for conservation led him to collect, identify, and work on the classification of more than 24,000 such plants native to Idaho. He donated his herbarium to the University of Idaho before leaving for Hawaii.

One of the founders of the Soil Conservation Society of America, he served as the first secretary-treasurer, and as a member of the council. He also served a term as first vice president.

FRANK L. DULEY, *Lincoln, Nebraska.* Dr. Duley is Senior Soil Conservationist, Soil and Water Conservation Branch, Agricultural Research Service, U.S.D.A. His whole life has been dedicated to soil conservation work. At the University of Missouri, Dr. Duley helped set up the first plots in the country designed to study effects of cropping systems on runoff and erosion. In Kansas he worked on the effect of terracing and length and degree of slope on soil erosion. In Nebraska he pioneered in the development of the stubble mulch system. Author of 28 research bulletins and 44 scientific journal articles, Dr. Duley is considered an international authority on the use of crop residues in soil and water conservation.

Prior to this work for which he is widely known, he obtained his B.S.A. and M.A. degrees from the University of Missouri, his Ph.D. in soils from the University of Wisconsin.

He served on the staff at the University of Missouri from 1915 to 1925. He was Professor of Agronomy at Kansas State College from 1925 to 1933 when he became Regional Director of the Soil Erosion Service. Since 1936 he has led a research team in soil and moisture conservation, first with the S.C.S. and now the Agricultural Research Service. His associates have stated: "Dr. Duley's life has been truly one of dedication to the ideals of soil conservation in the gathering of facts and their dissemination."

ROY D. HOCKENSMITH, *Washington, D. C.* A native son of Missouri, Mr. Hockensmith received his B.S. and M.S. degrees from the University of Missouri. For a time he served as assistant in soils at his alma mater, and later at Colorado A. & M. College. From 1934 to 1937 he was a soils appraiser for the Federal Land Bank.

Since 1937 he has been with the Soil Conservation Service and is now director of soil survey operations. He has specialized in soil classification and mapping, with special emphasis on soil and land classification as a basis for soil conservation.

Author of many scientific articles, he has also represented the United States at several international meetings. The latest was the Fifth International Congress of Soil Science at Leopoldville, Belgian Congo, in 1954. He is a charter member of the Soil Conservation Society of America. He served a term on the national council and is now chairman of the organization and policy committee.

PAUL G. McGREW, *Spokane, Washington.* Now state conservationist in Washington, Paul C. McGrew was graduated from the University of Nebraska in 1923. He immediately joined U.S.D.A. and did research work in the drainage division until 1929. At that time he started work on soil erosion studies at the Guthrie Soil Erosion Experiment Station in Oklahoma.

Later he was in charge of the soil and water conservation research work at the Pullman, Wash., Soil Erosion Experiment Station. From 1937-1942 he served as assistant regional conservator for the Soil Conservation Service in Washington, Oregon, and Idaho. He served for two years as assistant state conservationist and in 1945 assumed his present assignment.

Mr. McGrew served as second vice president, Soil Conservation Society of America, in 1952. He has been a member since the Society's formation and has served on many other national and local chapter committees.

J. S. RUSSELL, *Des Moines, Iowa.* The Society's tenth president, Mr. Russell is respected by agricultural leaders throughout the world for his writings on agricultural problems and accomplishments.

He was graduated from Grinnell College and farmed in Jasper County, Iowa, before entering the Army in 1918. He operated a weekly newspaper following the war until 1925 when he assumed his present position as farm editor of the *Des Moines Register and Tribune.*

During 1942 and 1943 he served as Deputy Administrator, Food Distribution Administration, and as Assistant to War Food Administrator, War Food Administration.

He is Deputy Chairman of the Farm Foundation and the Federal Reserve Board of Chicago. Mr. Russell has served on several committees for the United States Department of State and U.S.D.A.

He visited Western Europe in 1947 and 1953 reporting on food, agriculture, and land conditions. In 1952 he visited most of the countries of Asia on a similar assignment. During 1954 he again visited Asia as a member of the U.S. Trade Mission studying markets for farm products.

He has been active in promoting soil conservation field days and at present his company has a program recognizing work accomplished by soil conservation districts with land owners, tenant farmers, and new cooperators. He served as treasurer of the Soil Conservation Society of America for three years, vice president, and in other capacities.

JAMES K. VESSEY, *Milwaukee, Wisconsin.* "Jim" Vessey, as he is widely known, has a knowledge and understanding of the need for safeguarding the nation's renewable resources and has served the cause with great enthusiasm.

He is a graduate of Pennsylvania State University and served in private industry for eight years prior to joining the Forest Service, U.S.D.A., in 1933. He is now Assistant Regional Forester in charge of the Division of State and Private Forestry, a position he assumed on June 1, 1956.

He served for six years as Assistant Regional Forester in charge of the Division of Information and Education at Missoula, Mon-

J. S. Russell

J. K. Vessey

Ernest Walker

Nelson R. Crow

Cecil Hagen

Howard Miller

tana. For a number of years he held similar positions in Philadelphia and other points in the Northeast.

In his time with the Forest Service he has been instrumental in developing high-standard public forest land management programs and in encouraging and initiating similar programs on state and private lands. Conservation-wise, his influence has been national in scope. His acquaintance with persons and programs of public and private interests is unequalled.

Mr. Vessey is a charter member of the William Penn Chapter. He served on the national council for two years and is currently second vice president. He was chairman of the committee that revised the philosophy and objectives of the organization. He has been instrumental in developing interest for the Society among foresters.

ERNEST D. WALKER, *Urbana, Illinois.* Mr. Walker, a native of Illinois, was graduated from the University of Illinois College of Agriculture in 1910. He operated the home farm until 1921 when he became County Agricultural Agent in Butler County, Missouri, with headquarters at Poplar Bluff.

In 1924 he became farm advisor in Henderson County, Illinois, where he remained until 1934. During 1934 and 1935 he was employed by the Agricultural Adjustment Administration.

In 1936 he was appointed extension agronomist with the University of Illinois College of Agriculture, becoming extension soil conservationist in 1941. He held this position until his retirement September 1, 1955. During his services as extension soil conservationist, Mr. Walker actively assisted in the organization of 91 out of the 97 soil conservation districts in Illinois.

While on sabbatical leave in 1951, he studied educational programs on soil conservation and administrative organization and relationships in 31 states as well as in Canada and Mexico.

Mr. Walker has served the Soil Conservation Society on a number of committees. In 1952 he was chairman of the Nominating Committee, he served on the Finance Committee during 1950, the Organization and Policy Committee during 1953 and 1954, and on the Watershed Management Committee during 1956 and 1957. He has also been active in chapter affairs.

HONORARY MEMBERS—*This recognition goes to individuals who are not professionally engaged in conservation. They are selected on the basis of their contribution to soil and water conservation and without regard to membership in the Society.*

NELSON R. CROW, *Los Angeles, California.* Founder of the Crow publications—*Western Livestock Journal, Mountain and Plains* section of *Western Livestock, Western Dairy Journal,* and *Farm Management*—Mr. Crow started as a publisher in Fairfax, Missouri, at the age of 21 when he purchased a country weekly.

Following World War I, he was a market reporter for *Chicago Drovers Journal* and later served U.S.D.A. as market reporter. The Department transferred him to California where he established the first market reporting service at the Los Angeles Union Stockyards. In 1922 he left U.S.D.A. to start the company now matured to its present position of leadership in the agriculture field.

Nelson Crow has worked closely with the many agencies and groups promoting soil conservation. He has recognized the soil resource as basic to all agriculture. He has given his wholehearted support to furthering soil and water conservation knowledge in a sound manner. Special issues of his publications have been devoted to soil conservation. He has been aggressive in encouraging articles relating to all phases of the movement.

CECIL HAGEN, *Spokane, Washington.* From a boy on a wheat ranch in the rolling hills of eastern Oregon to respected agricultural journalist has been the career of Cecil Hagen.

A graduate of the University of Idaho with a degree in journalism, Mr. Hagen became assistant in publications on the University staff and edited publications, agricultural bulletins and releases for 13 years before he became Associate Editor of the Farm Trio in 1943. The Farm Trio published *The Idaho Farmer, The Washington Farmer,* and the *Oregon Farmer* at that time. In 1949 Hagen became managing editor and soon another paper, *The Utah Farmer* was added, to make it the Farm Quad.

Editorials, prepared by Cecil Hagen brought the work of soil conservation districts and the need for public support of their objectives to the attention of farmers, advertisers, businessmen, and the public.

His leadership in the Northwest has advanced soil conservation in many ways. He has devoted countless days searching for conservation articles, speaking on soil conservation, and working with young people and adults to speed the acceptancee of conservation practices.

HOWARD S. MILLER, *Hiawatha, Kansas.* Born in Pennsylvania, Mr. Miller has spent more than 70 years in Brown County, Kansas. He is a graduate of the University of Nebraska with a law degree. He never actually practiced law, for he returned to his home farm to assist his mother in rearing six minor children.

Mr. Miller was one of the early producers of certified brome grass seed. He has carried out an excellent conservation program on his own land. He assisted in the development of the Northeast Corn Belt Experimental Farm and in organizing the Brown County Soil Conservation District.

He served as Congressman from his district in the 83rd Congress. He introduced legislation to allow deductions from income tax for soil conservation measures and for individuals to obtain loans through Farmers Home Administration for soil conservation work. He is well known for his bill to de-authorize the Tuttle Creek Dam.

Mr. Miller is a strong advocate of the small watershed approach to conservation and flood problems and served as chairman in the organization of Walnut Creek Watershed. He is a member of the Pony Express Chapter and has been active in Society affairs.

T. W. THORNHILL, *Charleston, South Carolina.* A graduate of Clemson College, Mr. Thornhill is a business man and soil conservationist. He owns a farm and has practiced conservation in addition to advocating it throughout the South.

Since 1945 he has served as a supervisor of the Charleston Soil Conservation District. For a number of years, he served on the State Soil Conservation Committee. He has worked with the National Association of Soil Conservation Districts, and participated in their national meetings, and served on their committees.

His influence on soil conservation has been wide-spread. He promoted the publication of a 10 year report of district accomplishments in the *Charlestonian,* a widely distributed monthly magazine published by the Charleston Chamber of Commerce. Mr. Thornhill has served the Episcopal Church, the Boy Scouts, the Southeastern Tidewater Experiment Station, the Coweeta Hydrological Laboratory, the Toogoodoo Watershed, and many other groups.

In all his associations with these groups, he has promoted conservation. He is truly a "soil conservationist."

D. L. Strathearn

T. W. Thornhill

A. Threlkeld

AUGUSTUS THRELKELD, *Corinth, Kentucky.* Mr. Threlkeld was born and reared among the Eden Hills of northern Kentucky and has spent his life farming, except for a period to receive his college training at the University of Kentucky.

His land is hilly and steep. He became aware of a serious erosion problem and set out to find ways to control it. When some of the methods worked, they were adopted by his neighbors.

After leading a group of Kentuckians to study early soil conservation districts in Oklahoma, he assumed the job of getting an enabling act passed in Kentucky to allow similar districts. Despite opposition, this was accomplished in 1941.

Mr. Threlkeld helped organize the first Farm Bureau in his county. He has been chairman of the Grant County Soil Conservation District since its origin and led in the organization of the Kentucky Association of Soil Conservation Districts. With other men, he helped set in motion the organization of the National Association of Soil Conservation Districts.

He has served other groups including the Burley Tobacco Growers Cooperative and the Production Credit Association. He has been a member of the Soil Conservation Society of America since 1949.

In all things he regards as being good for the body politic, "Uncle Gus", as he is known among his close associates, has given of his time, energy, and personal funds far beyond the call of duty.

DAVID L. STRATHEARN, *Simi, California.* Chairman of the California State Soil Conservation Commission since 1948, and member since 1945, Mr. Strathearn was one of the first two soil conservation district directors appointed by the Governor of California.

He was instrumental in developing the soil conservation district movement in California and Nevada. He helped organize the California State Association of Soil Conservation Districts. He served on the range committee of the National Association of Soil Conservation Districts for a number of years.

Mr. Strathearn has been active in many community civic and governmental affairs. His extensive ranch and farm holdings in California and Nevada have soil and water conservation programs.

In addition to serving the local soil district board and the State Soil Conservation Commission, he is a member of the Governor's Council on Water Problems and is on the Ventura County Water Resources Board.

Mr. Strathearn is also president of Strathearn Cattle Company and director of Winthrow Pump Company and Ventura County Mutual Fire Insurance Company. He is on the Board of Trustees, Simi Valley School District, and is active in Boy Scouts. Dave Strathearn is truly a leader of the West in soil and water conservation.

New Journal Editor: Douglas E. Wade

DOUGLAS E. WADE, Columbia, South Carolina, has been named editor of the JOURNAL OF SOIL AND WATER CONSERVATION.

A charter member of the *Society*, Wade has broad experience in the conservation field. He has served with the Pennsylvania Game Commission, University of Missouri, Dartmouth College, University of New Hampshire, New Jersey State Department of Education and Clemson College. Since 1953 he has been Education Assistant with the South Carolina Wildlife Resources Commission where he was associate editor of South Carolina Wildlife.

Douglas E. Wade

Wade brings to the *Society* a varied experience in other conservation organizations. He has served as treasurer and vice president of the Wildlife Society and a director of Conservation Education Association.

For the past two years he has served on the editorial board of the JOURNAL.

Wade has been listed in the last two editions of *Men of Science*. He was an invited speaker, UNESCO Conference on Protection of Nature, 1949; and Second International Congress on Recreation, 1956.

His other editorial experience has included: editor, New Hampshire Audubon Bulletin; state reporter, Wildlife News; editor, Wildlife News; manuscript reader, Countryman Press; conservation editor, Wilson Bulletin; editor, New Hampshire Recreation Society; and editorial board, The Chat (Carolina Bird Club).

A native of Beloit, Wisconsin, Wade is a graduate of Beloit College. He also has a Master's Degree from the University of Wisconsin where he was a student of Aldo Leopold. He is married and the father of two children.

Alvin F. Bull has served as acting editor this past year, on a part-time basis. He is managing editor of Wallaces' Farmer and Iowa Homestead in Des Moines.

News Notes

PRESIDENT'S COLUMN

Many of the highlights of the program and reports at the 1957 annual meeting of the *Society* at Asilomar Beach State Park in California are being reported in this and subsequent issues of the JOURNAL. But there are some things of special significance which the membership should realize.

J. S. Russell

First of all, it was a good convention. With such headliners as Assistant Secretary of Agriculture E. L. Peterson, Dr. R. G. Gustavson, and many others, we have a new awareness of the importance of water, not only in connection with conservation but in our whole economy.

From the standpoint of the *Society* itself, there are a few accomplishments of which we can justly be proud.

We broke through the barrier of 7,000 members and came up to convention time with more than 7,300 members. That's a new high mark. Credit should go to North Carolina for being first place in membership. And to Mississippi for the greatest gain. Georgia, Michigan and Iowa did mighty well, too.

The chapter awards stand out as a real accomplishment. The Michigan chapter was national winner. Regional awards went to North Carolina, Southern New England and Inland Empire chapters.

One of our objectives set up at the 1956 annual meeting was to have a full time editor for the JOURNAL. And now, in Douglas E. Wade of South Carolina, we have a fine one. He is not only a man with conservation and editorial experience, but is a charter member of the *Society*. He also has served as a chapter officer.

The selection of new officers brings a good team to bat for next year—Russell Hill, A. C. Watson, Elmer Sauer, Wayne Pritchard, and Howard Barrows.

But so much for accomplishments. There is much left to be done. And just how do we go about further implementing the objectives of our *Society*?

In this connection, both teamwork and leadership should be emphasized. The very nature of the organization indicates teamwork and co-ordination of the various agencies, organizations and individuals concerned with advancing the art and science of good land use. This, of course, includes water use. Soil must have water to make it of use to man. So conservation of land and water resources go hand in hand.

Perhaps we do not stress enough the importance of soil and water to man.

Lack of water is, and will continue to be for the foreseeable future, one of the limiting factors in agricultural and industrial expansion.

It is for use by people in all walks of life that we as individuals and as a *Society* accept responsibility for backing a good land and water use program. I would also include wise use and conservation of timber and wildlife.

It is a responsibility of members to measure up, and to help the *Society* measure up, to these obligations.

How can we accomplish this teamwork and provide the needed leadership toward better conservation and use of our renewable natural resources?

Part of this is by individual efforts, of course. Most members are already contributing to the objectives of the *Society*. Many chapters are practicing teamwork and leadership in projects now underway.

Certainly, one activity which we can all advance, to the benefit of everyone concerned and in the best interests of conservation, is the development and management of watersheds. I should like to suggest to the incoming officers for 1958 that this be given a high priority at all levels. The watershed brings together soil conservation, water control, use of forests, wildlife management, and recreation development.

Sometimes I think the *Society* as such should have a voice and indicate a stand on matters affecting the objectives of the *Society* itself. Certainly, this does not mean lobbying, getting into politics, or "firing from the hip" on every controversial issue that arises.

But there are different ways of speaking up. The council meeting in Monterey, California, favored a plan for development of policy statements by authorized committees.

Here are a few things that would seem to me, as a *Society* member, to be in the interest of the *Society* objectives:

1. Support watershed programs.
2. Stress need for upstream treatment for flood control and water protection.
3. Improve public relations for conservation. For example, reported abuses of the soil bank program should not be permitted to reflect on soil conservation. Yet, that happens now and then.
4. Emphasize the danger of having too much of our better farm lands shifted to non-agriculture use. It sn't just the amount of land, but the quality, that counts.
5. Work with other organizations, such as the National Association of Soil Conservation Districts, toward such projects as the watershed congress and soil stewardship week observance.
6. Add our support behind others who move in a sound direction on conservation matters. For example, I think the congressional committee was on the right track when a unified soil conservation budget was recommended in place of the piecemeal units now existing for SCS, ACP, conservation reserve on soil bank, Great Plains Program and the like.
7. Speed up the classification of land and the inventory of soil and water resources.

Of course, there are many more places where the *Society* could add a considered, and perhaps influential, voice.

But it is by our deeds rather than our words that we will be judged.

So let me say again that the individual member of this *Society* does have a responsibility to work for the advancement of the art and science of good land use and for the conservation and wise use of our renewable natural resources. This is for the good of all of us.

The conservationist can not be a person who looks backward but one who faces the future, who has concern for this and future generations, and who is willing to work for the protection of resources for future use.

—J. S. RUSSELL, *President*

Russell G. Hill Elected President for 1957

Russell G. Hill of East Lansing, Michigan, was elected president of the *Soil Conservation Society of America* in the annual election. The election was conducted by mail ballot of all the members. Results were announced at the recent meeting in California.

Hill is executive secretary of the Michigan State Soil Conservation Committee as well as extension specialist in soil conservationist at Michigan State University. A native of Michigan, Hill earned both B.S. and M.S. degrees from Michigan State University.

Hill has long been active in *Society* affairs. He served as treasurer for five years

Russell Hill

and has been on the national council for 10 years. He has also been second and first vice-president. In addition, he has served on a number of committees.

Hill was named a Fellow of the *Society* in 1953. He also won a Distinguished Conservation Award presented by Nash Motors Company.

First Vice-President

Alvin C. Watson of Washington, D. C., was named first vice-president of the *Society* for 1958.

He is now director, Administrative Serv-

Alvin Watson

ices Division, Soil Conservation Service.

Watson is a native of Pennsylvania. He earned his B.S. and M.S. degrees from Pennsylvania State University.

Watson is a charter member of the *Society*. He served as national secretary for three years. He has served on numerous committees including organization and policy committee. He was elected a Fellow in 1952.

Elmer Sauer

Second Vice-President

Elmer L. Sauer of Urbana, Illinois, was named second vice-president of the *Society* for 1958. He is research liaison representative SCS-ARS for the Corn Belt States.

Sauer earned his B.S., M.S., and Ph.D. degrees from the University of Illinois. He is author of numerous articles in the field of soil and water conservation including contributions to the JOURNAL OF SOIL AND WATER CONSERVATION.

Sauer is a charter member of the *Society*. He is chairman of the editorial board, for the JOURNAL and a member of the national council. He served as program chairman for the 1952 annual meeting.

Treasurer

Re-elected treasurer for a third term was Howard F. Barrows, Hinsdale, Illinois.

Howard Barrows

He is conservationist for Austin-Western Works at Aurora, Illinois.

Barrows has long been active in the conservation movement. He was first chairman of the Northern Illinois chapter. He has served as chairman of Business and Organization Relations Committee of the *Society* for six years.

Barrows assisted in establishing a new accounting system for the *Society*. He has faithfully attended annual and council meetings.

Council

Elected to serve a three-year term as council member at large was Firman E.

Firman Bear

Bear of New Brunswick, New Jersey. Bear, now retired, has been chairman of the Soils Department at Rutgers University. He is editor of *Soil Science*.

Bear received B.S. and M.S. degrees from Ohio State University. He earned his Ph.D. at the University of Wisconsin.

Bear, a past president of the *Society*, has served on the national council for many years. He has been named a Fellow of the *Society*.

Minott Silliman

Minott Silliman, Jr., of Kankakee, Illinois, was elected to the national council for a three-year term to represent the north central region.

He is area conservationist, SCS, for northern Illinois.

Silliman received his B.S. degree from the University of Illinois.

He is a charter member of the *Soil Conservation Society of America*. He has served on numerous national committees for the *Society*. He has also been active in his local chapter.

John W. Barnard of Washington, D. C., was elected to a three-year term on the

John Barnard

national council as representative of the northeast region. He is Head, Conservation Needs Section, SCS, and chairman of the USDA Committee for the National Inventory of Soil and Water Conservation Needs.

Barnard was graduated from West Virginia University. He has been active in local chapter affairs in both Pennsylvania and Washington, D. C. He is a charter member of the *Society*.

First Report of 1957 Annual Meeting

More than 630 people registered for the Society's twelfth annual meeting at Asilomar Beach State Park, Pacific Grove, California. This number included nearly 200 wives and children. All enjoyed the facilities available and the California hospitality provided by Western members and friends of the Society.

Nolen Fuqua, president of the National Association of Soil Conservation Districts,

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Another Summers' Cartoon . . .

"THIS FIELD SURE SPRUNG A LEAK!"

writing in the Tuesday Letter for that organization, stated: "The meeting was held on fabulous Monterey Peninsula where vegetables grow like in the Garden of Eden." Members who enjoyed the vegetables and fruit provided by California hosts would agree with Nolen. The "snack-bar" was continually filled with fruit from many parts of California.

A field tour during the meeting gave visitors the opportunity to see the agriculture in the highly productive Salinas Valley where lettuce, beans, broccoli, carrots, sugar beets, tomatoes, strawberries, and many other vegetables and field crops are produced in the "air conditioned" fields of the valley. Farmers in the area have the choice of more than 50 crops and Monterey County, California, markets more than $60 million dollars a year in vegetable crops.

The visit to Salinas Valley where agriculture depends on irrigation set the stage for the theme of the Society's meeting—**water.**

Immediately following the tour, the Monterey County Soil Conservation District, with Ray Rianda in charge, prepared and served a barbecue provided courtesy of ORTHO PRODUCTS of California Spray-Chemical Corporation. The California Wine Industries provided additional incentive for attendance at the evening session.

At the opening session on Wednesday, August 28, President Russell issued a challenge to all members and to all chapters of the Society to keep America strong in resources as well as beautiful. He suggested the Society can and does serve as a catalyst, bringing into closer relationship the various specialists, scientists, professional men, technicians, soil district supervisors and others. He suggested the continued need for coordination of conservation efforts—that carrying out the objectives of the Society would speed the process.

Other highlights of the program included Reuben G. Gustavson, President, Resources For the Future, as keynote speaker who told the group assembled about: *"Water—the Nation's Concern Today—A Problem Tomorrow."* Louis Warrick, U. S. Public Health Service, discussed, *"Increasing Water Problems For Industry and Municipalities."* Louis Rozzoni, President of California Farm Bureau Federation, reviewed, *"Increasing Demands on Water For Agriculture."*

E. L. Peterson, Assistant Secretary of Agriculture, spoke on, *"Problem of Water For the Future."* Nolen Fuqua, President of the National Association of Soil Conservation Districts, told about, *"The Coordinated Watershed Approach to Soil and Water Problems."*

Edward Cliff, Assistant Chief, U. S. Forest Service, reported on, *"Recreation and Wildlife Requirements For Water."* Howard T. Orville, Chairman of the President's Advisory Committee on Weather Control, discussed, *"Weather Modification, Problems and Possibilities of Increasing Supplies."* Morlan W. Nelson, SCS Snow Survey Supervisor, spoke on, *"Can We Predict Our Available Water Supplies?"* C. L. Forsling, Director, Forest and Watershed Conservation Research, Charles Lathrop Pack Forestry Foundation reviewed, *"The Water Challenge of the Southwest."*

Harvey O. Banks, Director of California Department of Water Resources, talked on *"Can Water Become a Non-Limiting Asset?"* Marvin Anderson, Associate Director of Iowa State College Extension Service, discussed *"Improving Public Understanding of Water Policies and Problems."* O. J. Kelly, Agricultural Research Service, told of *"Streamlining Research to Fit Expanding Water Demands."* C. E. (Mike) Busby discussed *"Modernizing Legislation For Sound Water Use and Development."*

Technical committees reported on Saturday morning in addition to Karl Belser, Santa Clara, California, Planning Commission, who spoke on *"Urbanization and Non-Agricultural Uses of Agricultural Land."*

C. L. Hunt and C. R. Patton of North Carolina were present to encourage members to attend the 1958 annual meeting to be held in Asheville, North Carolina, October 19-22, 1958.

Herbert C. Fletcher of Boise, Idaho, served as chairman of the program committee while Fred A. Haughton, Jr., served as head of local arrangements. W. T. Hartman headed the local finance committee; John Dean was in charge of the "Gold

Rush" awards and the snack bar; Marvin Dodge handled all reservations and registration with the able assistance of J. W. Garlinghouse. Herb Boddy headed an active publicity committee while Charles Ahlson, an old friend of the Society, worked with others in arranging an outstanding exhibit.

Mrs. Helen Hoxie of the Monterey Peninsula Convention and Tourist Bureau assisted in many ways but especially with transportation. Waldo Wood served as chairman of the committee drawing maps for Society members. Ray Rianda was chairman of the barbecue committee while Eugene Thomas and his committee arranged the tour. Hospitality was handled by Richard Wagner and his committee. Mrs. C. H. Gleason served with Mr. Wagner and arranged for ladies' activities. Clark H. Gleason was chairman of the general steering committee and was assisted by Herbert A. Hopper, Western Region Council Member of SCSA.

Space will not permit a full review of the annual meeting in the September issue but more about it will appear in the November issue.

Annual Meeting Papers Now Available

Registrants at the recent annual meeting of the Society who failed to obtain copies of papers presented may request them from the national office, 838 Fifth Avenue, Des Moines 14, Iowa. Non-registrants may obtain them by sending one dollar ($1.00) to cover cost of assembly and mailing. Single copies may be secured for 10 cents each.

The papers are in mimeograph form. They will be available for mailing about October 1, 1957. Later, several will appear in the JOURNAL OF SOIL AND WATER CONSERVATION.

Members may check the July issue of the JOURNAL for a list of the presentations made.

Musser, Society's First President, Dies

Ralph H. Musser, first president of the Soil Conservation Society of America, died in Washington, D. C. on September 11 after suffering a heart attack in late summer. Since November 1953, he had been field representative of the Soil Conservation Service for the southeastern states. He joined SCS in 1935 and from 1937 until 1953 served as regional conservator, first in Des Moines and later in Milwaukee.

Mr. Musser was one of the Society's outstanding leaders and held membership card No. 2. He served actively until his death. For the past several years he had been chairman of the Fellows and Honorary member committee and just prior to the twelfth annual meeting, while in the hospital, had written President Russell and the national office that he could not attend the California event and suggested that another member of his committee, J. C. Dykes, be called on to present the award certificates. Along with Mrs. Musser, he had attended all past national meetings of the Society. In addition to his wife he is survived by a son and a daughter.

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served two terms on the national council and was on the committee that worked for the establishment of the national office and the employment of an executive secretary. For a number of years he was custodian of the Society archives. He was named a Fellow in 1947, the second individual to receive such an honor. The first was his friend, Hugh Hammond Bennett.

In July of 1946, the JOURNAL OF SOIL AND WATER CONSERVATION was first published. The first article in the new publication was entitled "Why Another Society." This article by Ralph Musser outlined the objectives of the Society that have served as the major guides through the years. In this article he also stated: *"In hundreds of soil conservation districts, on thousands of farms and ranches, in schools and universities, in research stations, in business concerns, and in government, men are turning an increasing share of their attention to the ways and means of protecting irreplaceable soil and water resources. What we are witnessing today, however, is only the beginning. As the years go by, the urgency for soil and water conservation will become ever more compelling. Clearly, too, its application will become more exacting."*

Later in the same article he continued: *"The Soil Conservation Society of America begins its work at a propitious hour in history. Throughout the world there is a vast popular surge for a break from the exploitations of the past, for security, and for improvement in the standard of living. There is simultaneously a growing recognition of the value of natural resources and of the vital role they will play in shaping our future. Science itself is assuming a more prominent and a more practical role in everyday affairs. These are all hopeful, progressive signs. They provide an environment in which we may serve usefully."*

Ralph was proud of the Society and its accomplishments. He wrote the national office in January, 1956: *"The Society has grown, prospered and has accomplished many things far beyond reasonable prediction of 10 years ago."*

He was enthused by the 1956 annual meeting at Tulsa and wrote the membership, through the JOURNAL OF SOIL AND WATER CONSERVATION for November, 1956, pointing out that while the Society was reaching 7,000 individuals it should be reaching 20,000 people serving the cause of soil and water conservation. He outlined the Society program and suggested that each member should give his professional and non-professional friends the opportunity to join. He wrote about the annual meeting to be held in California and suggested that members should plan to attend. In his communique he was at that time really pointing to the 1958 annual meeting in Asheville, North Carolina, which was to be in his territory and he predicted more than 1,500 would attend. His enthusiasm for the Society knew no bounds.

Ralph H. Musser was one of the pioneer administrators of the Soil Conservation Service as well as a leader of the entire soil conservation movement, but his first love, his first concern, was for the Soil Conservation Society of America. The Society lost a dedicated member with his death.

the members of the Society assembled at the twelfth annual meeting sent the Mussers a telegram extending greetings and wishing a speedy recovery.

Ralph Musser was born in 1890 at Abilene, Kansas. He graduated from Kansas State College in 1914 and taught vocational agriculture in Twin Falls, Idaho, from 1914-17. He served as county agent at Caldwell, Idaho, from 1917-19 and as Assistant Extension Director for Idaho in 1919 and 1920. He served private industry in Idaho and Southern California from 1920 until he joined SCS in 1935.

On November 11, 1941, Ralph Musser was one of four men who met in Chicago and discussed the need for an organization such as the Soil Conservation Society of America. World War II delayed the formation but on February 16, 1943, at a meeting in Washington, D. C., it was agreed that such a society was desirable and the necessary steps were taken to organize. Ralph served as chairman of the organizing group. At the first annual meeting he was elected first president. Later he

H. H. Bennett Writes About Ralph Musser

Ralph Musser's passing is a bitter blow in many ways. To conservationists it means a costly withdrawal of a front-line man of action.

Ralph dreamed and breathed conservation and labored unceasingly for the objectives we have stood for across the decades. Sound land use, flood control, and prevention of siltation had become so solidly a part of his life and self that we can never disassociate these worthy purposes from his memory.

A few days before the last, I talked with Ralph in his sick room. He was feeling better; his doctor had permitted him to sit up a little. This brought an interval of cheerfulness. I saw a flicker of joy in his eyes when he said: "I shall be back home where I can be myself and catch up on conservation matters."

I have not known anyone more ready to divest himself of personal interests which he felt might in any way restrict his efforts to safeguard our remaining stock of productive land. His was a dedicated life. So devoted he was to the public's stake in the continuing security of the land, my studied appraisal of him amounts to this:

We have lost a devoted friend and cheerful co-worker whom we knew as a man of unflinching integrity, ever ready to share in all the effort required to accomplish worthy public ends. We are going to miss him, but we can never lose our awareness of his long list of helpful contributions to the cause in which we were happily joined as co-workers over a long period of time and accomplishment.

Ralph Musser did more than any of us to get the Soil Conservation Society of America off to a good start. And he was its first president.

—HUGH HAMMOND BENNETT, *Falls Church, Virginia, September 12, 1957*

Three Articles Chosen For 1957 Honors

Prior to the annual meeting members of the Society were given the privilege of voting on 17 articles from the JOURNAL OF SOIL AND WATER CONSERVATION, selected by the editorial board as meriting consideration.

Announcement of the three top articles chosen by the membership was made by Elmer J. Sauer, chairman of the editorial board, at the California annual meeting of the Society. The winning articles were:

Professional Leadership in Conservation, Edward H. Graham, Soil Conservation Service, Washington, D. C.

Impact of Urban and Other Development on Agricultural Land, Fred W. Herbert, Soil Conservation Service, Berkeley, California.

Principles of Crop Rotation, B. R. Bertramson, Washington State College, Pullman, Washington.

CHAPTER NEWS

Oklahoma Council of Chapters: Plans are under way for an outstanding meeting at Oklahoma City on September 27 and 28. The general theme of the program will follow that of the national convention with

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speakers and panel discussions on chapter progress, water policy in Oklahoma, responsibility of local people in watershed programs, irrigation, flood control, drainage, wildlife and water conservation.

Empire State: Summer meeting of the chapter was held at Genesee Falls Hotel, Portageville, N. Y. on July 26 and 27. Speaker for the event was E. W. Littlefield, Assistant Director of Lands and Forests, New York State Conservation Department.

"Show-Me" (Missouri): The summer picnic of the "Show-Me" chapter was held July 14 at Father Hildner's Gildehaus Church near Villa Ridge, Missouri. To quote speaker Elmer Sauer briefly, "The farmer realizes, more than ever, that he must integrate his faith with his daily life on the land and must re-evaluate those cultural and social advantages which rural living makes possible."

The "Show-Me" chapter had outlined a three point program for 1957 to include the state-wide summer picnic just mentioned; sectional meetings in each of the five areas of Missouri with a minimum of one meeting per area before January 1, 1958; and each section of the state to assume responsibility for one monthly newsletter.

North Dakota: The Western Wheels, Custer, Border, and Red River Valley chapters combined their resources to develop a state-wide meeting with tours of the Great Plains Field Station at Mandan, and Fort Lincoln Nursery at Bismarck. Noted speakers and guests included Dr. Cecil Wadleigh, Head of Soil and Water Conservation Research Division, Beltsville, Maryland; Dr. W. J. Staple, Physicist, Swift Current, Saskatchewan, and Dr. J. M. Caborn, Forester from Scotland.

Hoosier: On Saturday, July 27, members and friends met for a tour of Willow Slough State Game Area.

Ozark Mountain (Arkansas): Chapter prepared kits for distribution to key individuals. These were passed out on July 24 when area conservationists and others from the soil conservation service met in Eureka Springs.

Hollis R. Williams, state conservationist, acted as chairman of the meeting and introduced Vera Mohagen, Director of Personnel, SCS, Washington, D. C., who endorsed the active work and accomplishments of the *Society*.

Florida: A sub-chapter of the Florida Chapter was formed at Sebring on July 23. Ed Jesse, council member of the Florida Chapter, was in charge of the meeting. O. S. Polston, Sebring, was elected chairman of the new group; K. A. Harris, vice-chairman; and M. H. Carton, secretary.

Fred Sturges, Information and Education Officer for the Everglades Region of the Florida Game and Fresh Water Fish Commission, gave an illustrated talk on the subject, "Conservation is Big Business." Fred Stanberry of the same commission, gave a talk on the alligator weed.

Next meeting of the sub-chapter group was scheduled to be held in Fort Pierce on September 25.

Keystone (Pa.): The eleventh annual meeting of the chapter was held August 2 and 3 at University Park. Dr. Roy Matelski spoke on "Basic Studies of Pennsylvania Soils." Other topics included school camping and outdoor education, conserving human values and conserving the strength in family life.

Howard W. Busch was elected president. David G. Unger was named vice-president. John O. Rigo is secretary-treasurer.

Kentucky Lake: At the Annual Meeting of Soil Conservation District Supervisors in the group of 14 Western Kentucky counties in Area 1, the Kentucky Lake chapter sponsored a soil judging demonstration and contest for SCD supervisors. About 50 supervisors participated and "Hickory Walking Sticks" were presented to the 6 highest scorers. "They proved their interest and ability in soils," reported Wayne Williams, chapter chairman. "Out of a possible total score of 400 points, 6 supervisors scored from 316 to 359 points with James Gregory from Crittenden County, Kentucky placing first." The contest was held on the Kentucky State Prison Farm, Eddyville, Kentucky.—Wayne M. Williams, Murray, Ky.

Washington, D. C.: The chapter education committee, chairmaned by Murray Thompson, has just concluded its third annual luncheon meeting with key representatives from the seven school districts in the Washington, D. C. area and the adjoining metropolitan areas of Virginia and Maryland.

The chapter and the committee initiated this activity three years ago to develop an interest in the schools in conservation. The response from the school representatives has been exceptionally good and the committee is continuing to make selected reference material available in quantity to the various schools in the area for teacher guidance and school conservation projects.

Currently, guided tours are being arranged for teachers and students to the Beltsville Agricultural Research Center.

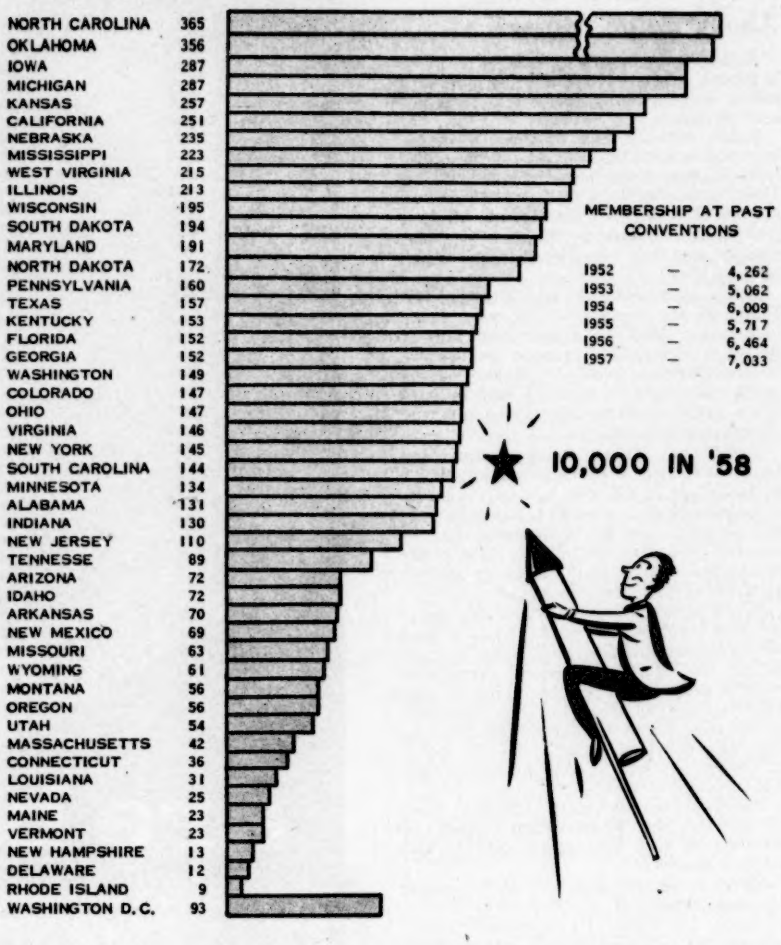
Chapter meetings during the spring featured:

1. A book review of top conservation books by the authors.
2. A discussion of the Potomac River basin development in relation to the land.
3. A panel on land use conversions and their impact on conservation.
4. The drouth problem and the Great Plains program.

For the fall meetings we are considering a series featuring:

1. Future possibilities in agriculture
2. Resources and national growth.
3. Population growth versus conservation.
4. The social action process in conservation.

SCSA Membership, August 1, 1957



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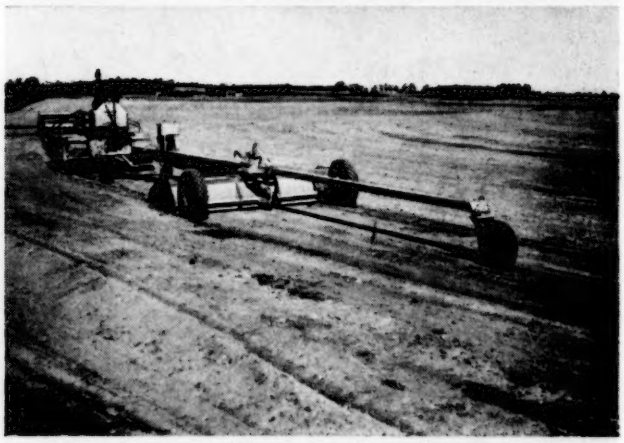

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